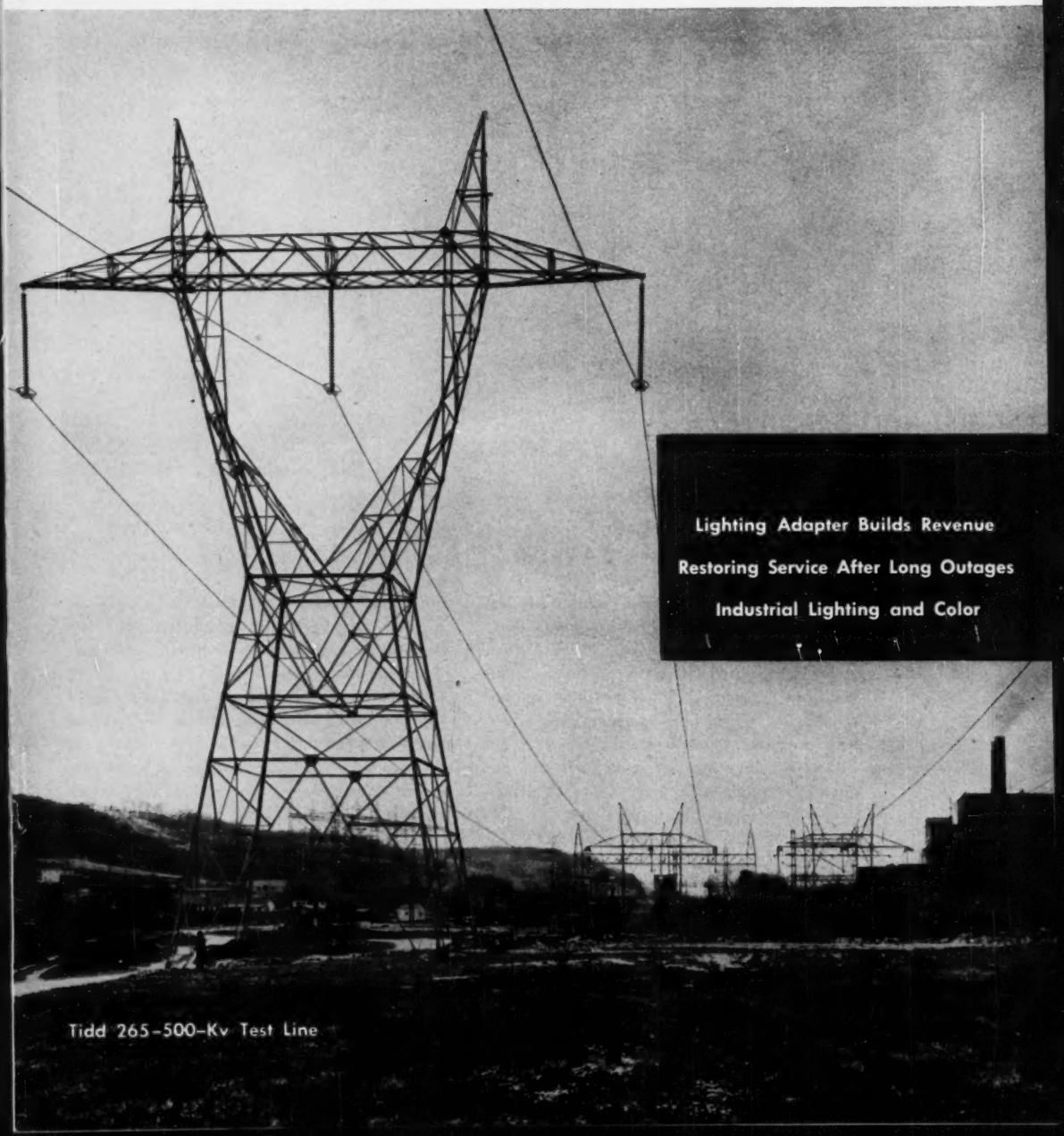
FEBRUARY 26, 1951

Electrical World

A McGRAW-HILL PUBLICATION



Lighting Adapter Builds Revenue

Restoring Service After Long Outages

Industrial Lighting and Color

Tidd 265-500-Kv Test Line

GIVE THESE BEARINGS EXTRA PROTECTION

Photo courtesy General Electric Company

Keep turbine systems free of rust, sludge and foam, by using TEXACO REGAL OILS (R&O)

You won't have to worry about "oil starved" bearings when your turbines are lubricated with *Texaco Regal Oils (R&O)*. These oils are famous for their ability to keep turbine systems free from rust, sludge and foam . . . assuring full circulation of lubricant to maintain normal bearing temperatures and to keep governor response instantaneous.

Only the finest base stocks are used in *Texaco Regal Oils (R&O)*. In fact, *Texaco Regal Oils* were world-famous turbine lubricants for many years before rust- and oxidation-inhibiting additives came into use. Now, with these additives—plus special processing to prevent foaming—*Texaco Regal Oils (R&O)* are truly outstanding. Count on them for extra-long service life . . . extra protection for your turbines.

Texaco Regal Oils (R&O) meet the stringent requirements of all leading turbine builders and are the choice of turbine operators everywhere. Let a Texaco Lubrication Engineer give you full details.

Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, New York.

TEXACO

TEXACO Regal Oils (R&O)

FOR ALL TURBINES

TUNE IN . . . TEXACO presents MILTON BERLE on television every Tuesday night. METROPOLITAN OPERA radio broadcasts every Saturday afternoon.

SPOTLIGHT ON INDUSTRY

In a "mobilization economy" such as we're swiftly getting into, everybody becomes acutely conscious of the power of American industry. Industry takes the center of the stage because industrial production can win modern wars and nothing else can.

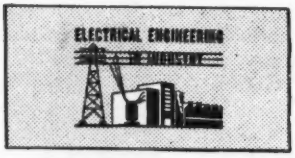
"Electrical World" is increasing and broadening its coverage of electricity in industry. In 1949, for example, we devoted a little over 49 pages to industrial. 1950 saw an increase of 45%, and in 1951 we plan to publish 67% more industrial news than in 1950.

Beginning in the forthcoming issue, we'll present a two-page spread devoted to power in industry, which will include "Industrial Briefs," "Industrial Application" and "How."

Talking all this over the other day, the editors were careful to point out that "Electrical World" has no intention of increasing industrial coverage at the expense of the other departments of the magazine. From fuel handling to final use of electric energy, our coverage of the industry will be as complete as ever.

One thing we want to make sure of is that "Electrical World" readers who are particularly interested in industrial power will be able to **identify** these articles quickly. We made a small survey among industrial readers not long ago—and found that some of them were missing articles of importance simply because they did not identify them quickly or realistically enough from the headline.

So we've decided to use the industrial symbol on every article whose principal subject is electric power in industry.



LIGNITE FOR FUEL

Up in Crookston, Minnesota, the Otter Tail Power Co has figured out a way to burn pulverized lignite and thus utilized a locally abundant material. Otherwise they'd have to ship in their fuel from quite a distance away. It's an interesting story, of basic significance and one of the features of the next issue.

Electrical World

Published for 77 years for those engaged in the business of generating, transmitting, distributing applying electric power

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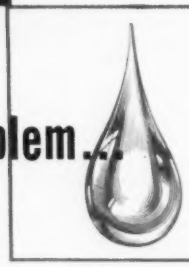
underwater

underground



wherever moisture is a problem...

"INSULATED WITH WATERTITE"

has meant TROUBLE-FREE CIRCUITS for over 20 YEARS

Millions of feet of Watertite rubber-insulated cables have been buried directly in the ground or installed under water in the past twenty years. These non-leaded cables have given safe, steady, trouble-free service because Watertite insulation has been compounded especially for these severe services—providing maximum moisture and heat resistance at no sacrifice of electrical and physical properties.

Time-tested Watertite will operate under the most difficult moisture conditions, whether in wet ducts, buried direct in the earth or totally submerged. Cables insulated with Watertite are available in the complete range of sizes up to 2,000,000 CM and for service up to 5000 volts. Both single and multiple conductor assemblies can be supplied with any type of outer finish.

Watertite insulation is approved for use on airport lighting cables under CAA Specifications L-824 and is approved by Underwriters' Laboratories as Type RW moisture resisting and RH heat resisting insulation. For complete information and engineering data on Hazard Watertite Insulation, write today for Bulletin H-422 to Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pa.

HAZARD

[illegible] wires and cables for every electrical [illegible]

8563

Electroline

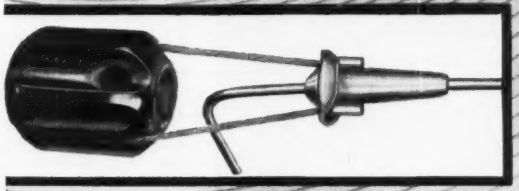
AUTOMATIC DEAD-ENDS

"AS GOOD AS NEW" AFTER TORTURE TEST

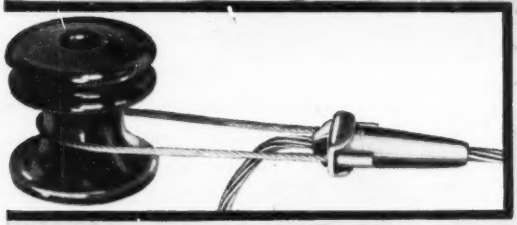
Electroline AUTOMATIC DEAD-ENDS are continually subjected to gruelling tests for strength, gripping and vibration damping features. In a typical test, 100,125,000 recorded vibrations did not develop any sign of failure of conductor in these dependable Dead-Ends. Month after month, day and night, these Dead-Ends held their positive grip and retained the full strength of the conductors. Engineers compute that the Dead-Ends withstood the equivalent of 50 years of ordinary service and state that they were as good as new at the end of the test.

The 3400-SERIES consists of an Electroline Automatic Connector, a yoke and flexible bail. These three are permanently interlocked once the conductor is inserted to form a complete unit that fits either strain or spool-type insulators.

This series permits the feeding of the conductor through the connector, eliminating the use of taps in the line span. The damping features incorporated in Electroline Dead-Ends prolong the life of conductors by preventing crystallization at the point of connection. They insure full line strength and save on construction costs by their quick and easy installation. These economical Dead-Ends can be reclaimed and used again. But, once installed, the conductor is there to stay; it cannot become detached until released by a lineman.



3400-SERIES



FOR COMPLETE DETAILS WRITE FOR BULLETIN.

TALENT TO ORIGINATE · E · ABILITY TO PRODUCE

Electroline Company

4121 South La Salle Street • Chicago 9, Illinois

In Canada: **POWERLITE DEVICES, LTD., TORONTO**

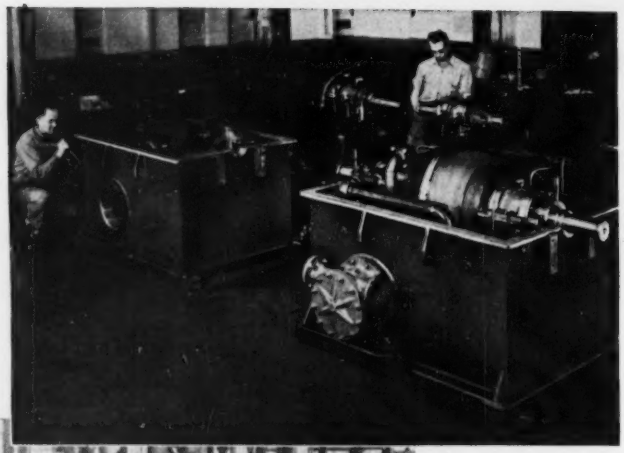
Gýrol FLUID DRIVES

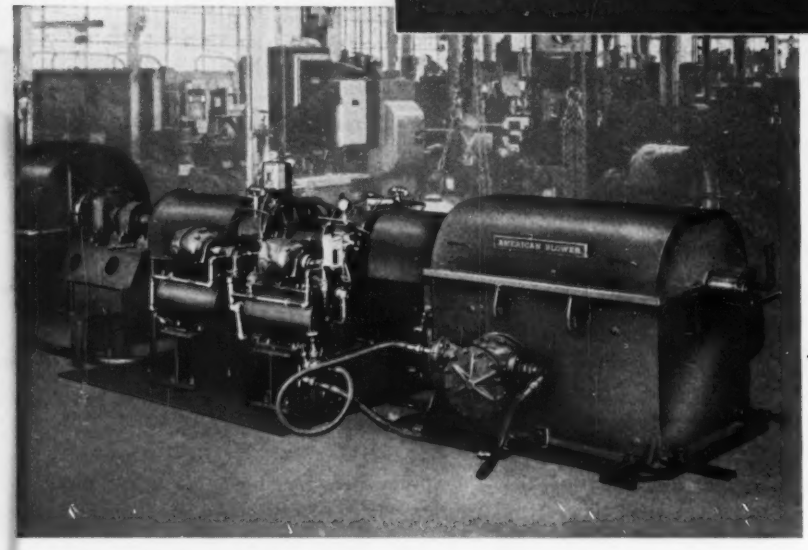
for

THE DETROIT EDISON COMPANY

CONNERS CREEK POWER PLANT

Ever-increasing demand for electric power has prompted still another of America's great public utilities to expand and enlarge its facilities and services.





Above are shown 2 of the Type VS Class 6 Gýrol Fluid Drives for boiler feed pumps, in process of assembly. A total of 6 will be used in The Detroit Edison Company's Conners Creek Power Plant. The duty of each is 1200 HP at 3600 RPM. This order is a duplicate of 6 units now in operation at their Trenton Channel Power Plant.

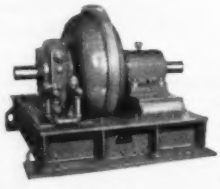
←**Each unit** is given a thorough run-in test. The narrow range of speed over which a boiler feed pump must operate requires very accurate control and this is insured by thorough testing and inspection at each stage of construction.

American Blower Type VS, Class 6 Gýrol Fluid Drive is designed especially for the heavy duty required of high speed boiler feed pump drives. It offers to power plant operators such important advantages as power savings, flexibility of control, lower pressures and reduced maintenance. For complete, concise, factual data on these unique drives—write, stating your requirements, or phone our nearest Branch Office.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN

CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation



Gýrol Fluid Drives

for Mechanical Draft Fans are also a part of American Blower's wide range of products which serve America's leading public utilities.

YOUR BEST BUY AMERICAN BLOWER POWER PLANT EQUIPMENT

Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

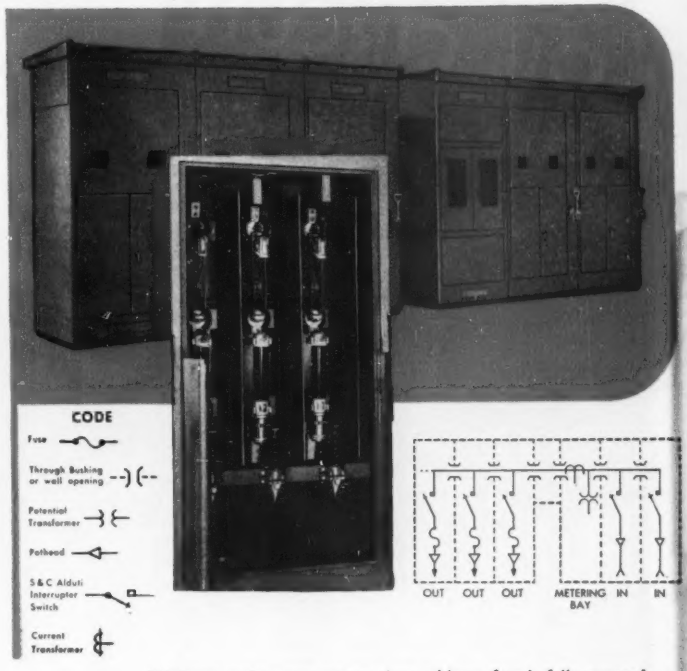
Saving Money

...with high voltage electrical distribution?

S&C Switchgear Units offer *30-60% savings* on substations and load centers

If you're planning to revamp your electric power system to get shorter cable runs, lower line losses and better voltage regulation, don't miss this opportunity to save money on equipment costs also. S&C Switchgear Units for modern high voltage switching stations, unit substations, and load centers have high interrupting capacity, and also offer large savings over circuit breakers.

Utilizing Alduti Interrupter Switches and SM Power Fuses, S&C Switchgear Units provide the switching performance and short circuit protection described below, right. In addition they provide:



One-package (unitized) metal-enclosed construction.

Ease and economy of installation because all equipment within each unit is factory assembled and connected. Incoming and outgoing connections are readily accessible.

Minimum maintenance expense since a blown fuse is fully restored by simple field replacement of its refill unit. Moreover, under usual conditions the switch requires no maintenance.

Service continuity since the reliability of S&C Power Fuses eliminates outages from surge-caused "sneakouts."

48-page booklet is yours for the asking. Consult telephone directory for S&C representative or write us direct.

Typical Performance Characteristics of S&C Switchgear Units

	VOLTS	SHORT CIRCUIT PROTECTION
	2,300 to 34,500	Expressed in 3-Phase KVA
	AMPERES	104,000 at 2,400 volts
Switches:	600, continuous and interrupting	180,000 at 4,160 volts
Fuses:	400, continuous, to 15,000 volts	448,000 at 13,800 volts
	300, continuous, to 34,500 volts	715,000 at 33,000 volts

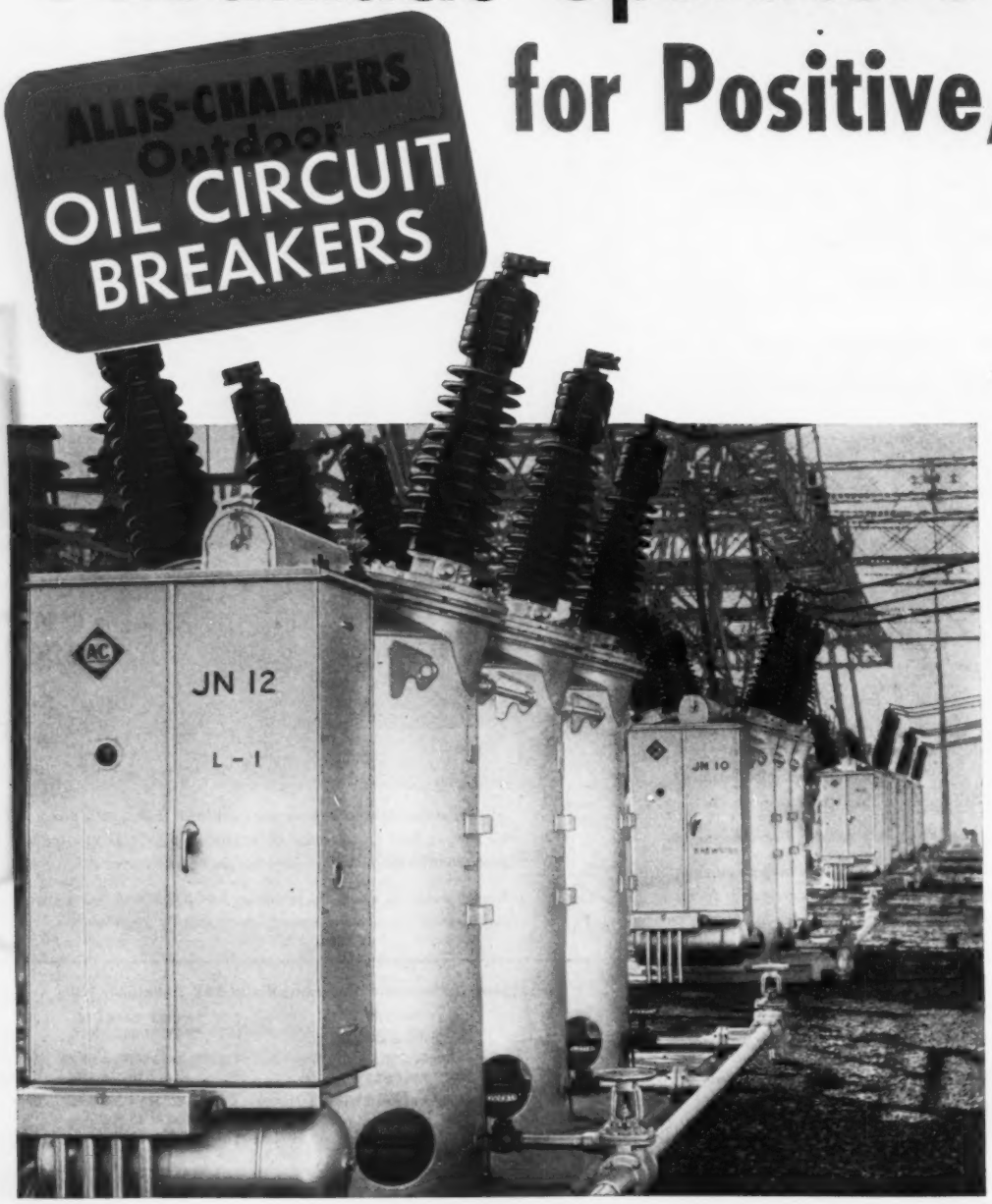
S&C ELECTRIC COMPANY

4421 Ravenswood Avenue
Chicago 40, Illinois, U. S. A.

Formerly SCHWEITZER & CONRAD, INC.

In Canada, Powerlite Devices, Limited, Toronto

Pneumatic Operators for Positive,



Type BZO-160 floor mounted, outdoor oil circuit breakers like these can be furnished in ratings from 69 kv to 230 kv, up to 10,000,000 kva interrupting capacity. Mechanically trip-free pneumatic operation is a standard feature in all of these sizes.

Mechanically Trip-Free Dependable Operation

★ *TRIPPING RELEASES CONTACTS FROM CLOSING MECHANISM*
★ *POWERFUL ACCELERATING SPRINGS FORCE CONTACTS OPEN*

WHEN A SEVERE storm or other abnormal condition disrupts your system, you need full protection against damage to your generators, transformers and other electrical equipment. But unless your breakers are mechanically trip-free there's a chance they may fail to reopen if they are reclosed against a fault condition.

Opening action of Allis-Chalmers breakers is immediate and positive because tripping positively uncouples contacts from the closing mechanism. Opening occurs whether the breaker is in normal closed position or is "closing in" on a short circuit.

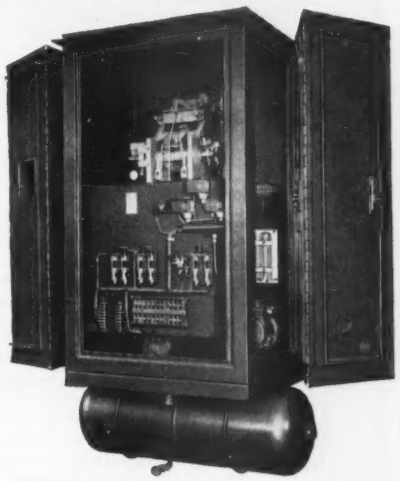
Allis-Chalmers mechanically trip-free design is your guarantee of dependable breaker operation. Breaker opening is independent of the closing piston and air valves. Maintenance closing devices cannot prevent the breaker from opening. There is no drag from the closing mechanism. These important advantages are included with every Allis-Chalmers power circuit breaker — whether pneumatic, solenoid or manually operated.

Designed for high speed reclosing, Allis-Chalmers circuit breakers combine fast-acting power of pneumatic operation with fast recoupling of contacts and reclosing mechanism.

Mechanically trip-free A-C circuit breakers are proving their dependability every day in utility and industrial applications across the country.

Call your Allis-Chalmers sales office for more information on power oil circuit breakers, and for a list of satisfied customers in your area. Or write Allis-Chalmers, Milwaukee 1, Wis., for new bulletin on the mechanically trip-free pneumatic operator. A-3230

Unitop is an Allis-Chalmers trademark.



WEATHERPROOF HOUSING with overhanging top protects the operating mechanism. Each housing includes a complete automatic air system, space heaters, electrically trip-free control system and air tank. Two double swinging doors provide access on three sides. Doors have a large safety-glass window that makes inspection easier. They can be padlocked with heavy duty latches. Ventilating louvres in doors exclude dust and insects.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

MECHANICALLY TRIP-FREE PNEUMATIC OPERATOR IS STANDARD EQUIPMENT ON ALL THESE ALLIS-CHALMERS OUTDOOR POWER OIL CIRCUIT BREAKERS

Type FZO-150 *Unitop* breaker 14.4 to 46 kv, 8-cycle opening, 20-cycle reclosing*

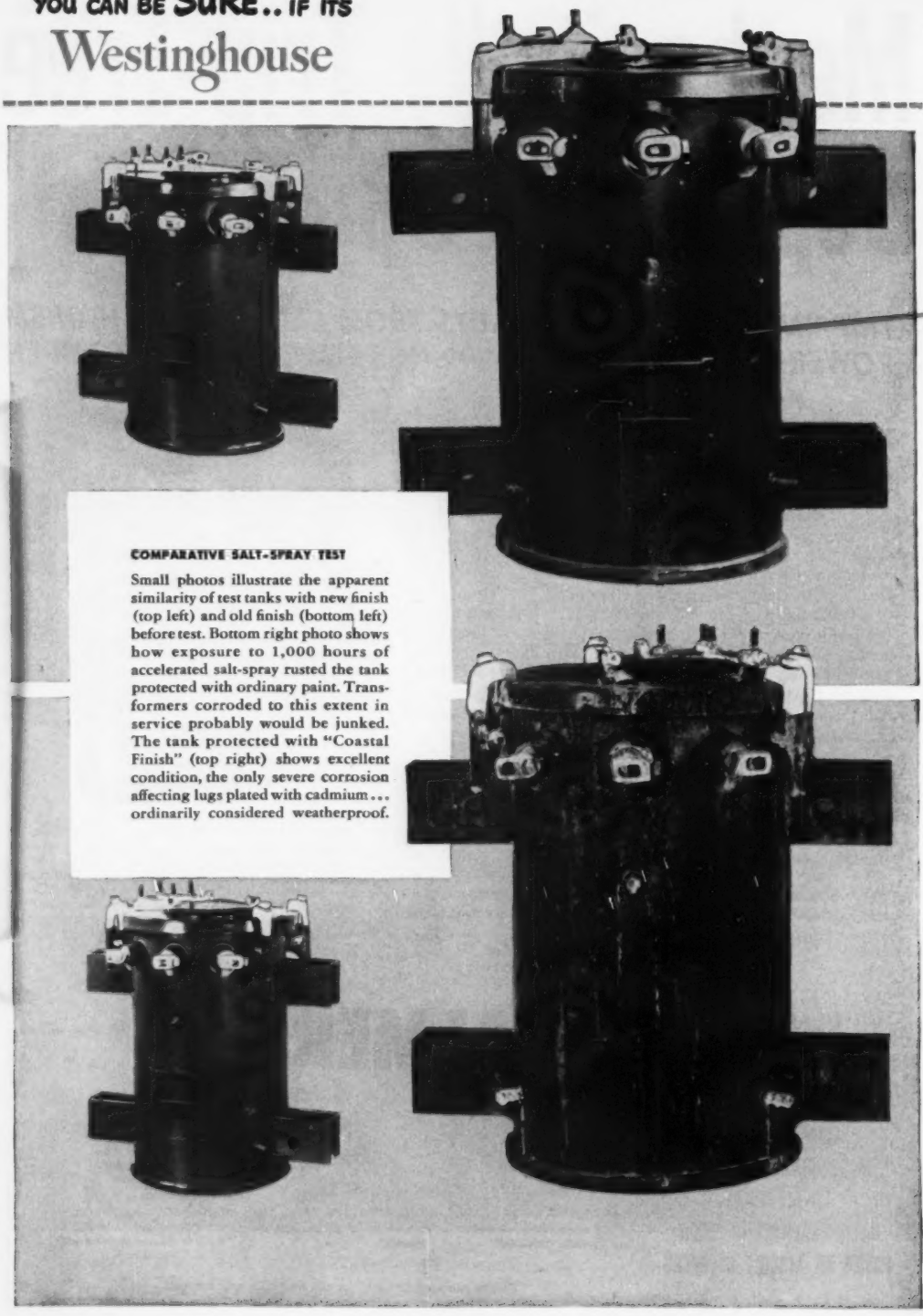
Type FZO-151 . . . 69 kv, 5 or 8-cycle opening, 20-cycle reclosing*

Type BZO-160 . . . 69 kv, 8-cycle opening, 115 to 230 kv — 3 or 5-cycle opening with 20-cycle reclosing*

*20-cycle reclosing standard for 600 and 1200 amp breakers

YOU CAN BE **SURE**.. IF IT'S

Westinghouse



COMPARATIVE SALT-SPRAY TEST

Small photos illustrate the apparent similarity of test tanks with new finish (top left) and old finish (bottom left) before test. Bottom right photo shows how exposure to 1,000 hours of accelerated salt-spray rusted the tank protected with ordinary paint. Transformers corroded to this extent in service probably would be junked. The tank protected with "Coastal Finish" (top right) shows excellent condition, the only severe corrosion affecting lugs plated with cadmium... ordinarily considered weatherproof.

—NEW "COASTAL FINISH"

New finish for Pole-Type Transformers adds years of protection under all service conditions

Greater resistance to chalking, cracking and rust! More than doubles the protective life of the finish! Adds years of service before repairing and repainting!

A new and better finish, developed in Westinghouse laboratories specifically to meet severe conditions of blistering heat, icy cold, rain, snow, salt and other corrosive atmospheres, *"Coastal Finish"* is now provided on all Westinghouse Distribution Transformers, "CSP"® and conventional.

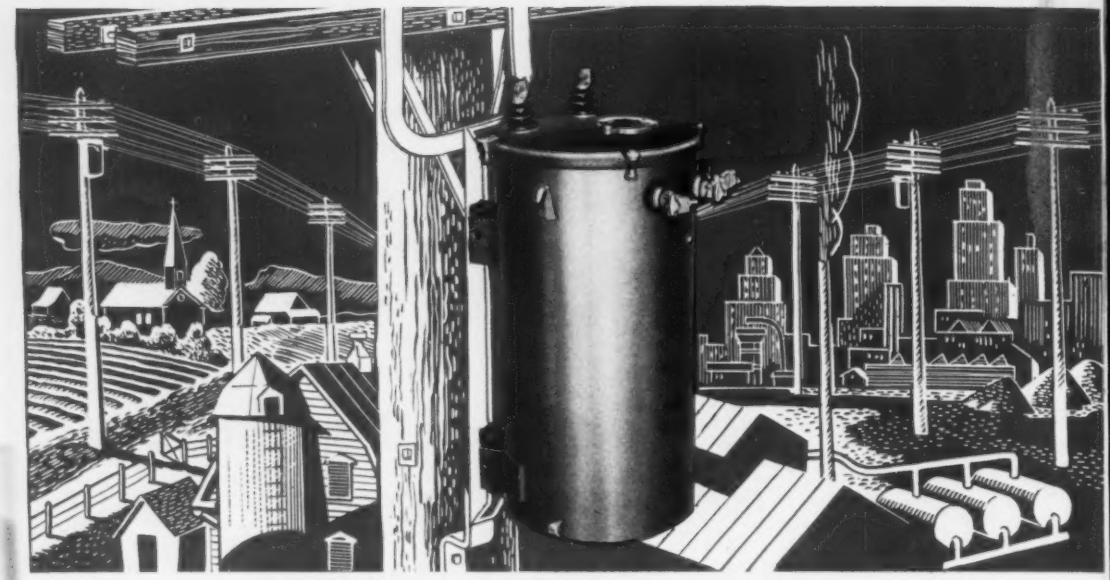
"Coastal Finish" consists of a primer coat to inhibit rust, an intermediate coat containing mica flakes that overlap like shingles on a roof to provide superior moisture resistance, and a final gloss coat that improves appearance, and filters out ultra-violet sun rays. Infra-red baking assures complete hardening of each paint film.

Comparative weathering tests . . . salt-spray, acid and alkali resistance, and weather-o-meter . . . clearly show the advantage of *"Coastal Finish"* in all types of atmospheres. This is *another plus value* in Westinghouse Distribution Transformers. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna.

J-70576

Westinghouse

DISTRIBUTION TRANSFORMERS



IT COSTS NO MORE TO BUY SOUND BASIC CONSTRUCTION

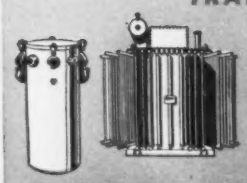
● Today, at The Standard Transformer Company, top-quality transformers are being produced for distribution systems all over the world — with no sacrifice of material for the sake of unimportant claims.

● Examine the Distribution Transformers illustrated on the right-hand page. Notice the easily removable cover, moisture-proofed with a Neoprene gasket to prevent oil leakage . . . note the rugged copper-bearing steel tank housing a low-loss core assembly of non-aging, varnish coated, silicon steel sheets . . . a coil that is wound in two sections to double heat radiation . . . ends that are not blanketed to induce free and effective oil circulation . . . a well-designed core clamping that assures quiet and efficient operation. These are some of the features that make Standard Transformers the best in their field.

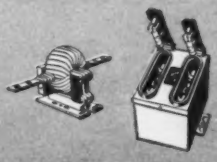
● It pays to buy sound basic construction. When you need transformer information, write for the name of your nearby Standard representative. He will help you with your selection, and describe our service fully.

. . . and remember . . . The Standard Transformer Company has built its reputation as a specialist in the design of transformers for every need. ● You write the ticket . . . Standard engineers and craftsmen comply with your specifications or requirements. You have complete freedom in your choice of accessories, such as Cubicles or Switchgear for Load Center or Substation Transformers, or other types that require them.

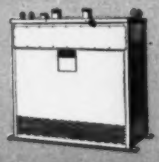
TRANSFORMERS FOR EVERY APPLICATION



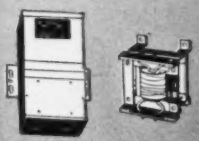
Liquid filled (sizes up to 10,000 KVA and 72 KV Inc.)



Instrument transformers (for use on circuits up to 72,000 volts, Inc.)



Dry type (up to 1000 KVA and max. voltage ratings of 4800)



Control transformers (compound filled or open type)

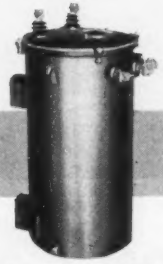
Standard
TRADE MARK ®

DISTRIBUTION TRANSFORMERS

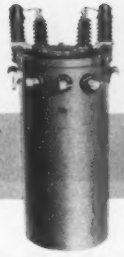
● Shown here are seven liquid filled* Distribution Transformers 7½ to 75 KVA. Standard manufactures a complete scale of Transformers up to 15,000 KVA.

Type A Distribution Transformer, single phase, 60-cycle, sizes through 7½ KVA, voltage 2400/4160Y to 120/240, with pocket mounted, high voltage bushings.

Type A Distribution Transformer, single phase, 60-cycle, sizes of 10 and 15 KVA, voltage 2400/4160Y to 120/240 or 240/480, with pocket mounted, high voltage bushings

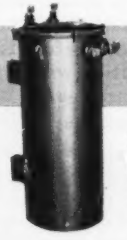


Type A Distribution Transformer, 37½ KVA, 2400/4160Y to 120/240 volts, single phase, 60-cycle, with cover mounted high voltage bushings.



Type CSP (completely self-protected) Distribution Transformer, 15 KVA, 7200/12470Y to 120/240 volts, 60-cycle, single phase with cover type high voltage bushings. ASA standard

Type CSP (completely self-protected) Distribution Transformer, 15 KVA, 2400/4160Y to 120/240 volts, 60-cycle, single phase with two pocket type high voltage bushings ASA standard



Type A Distribution Transformer, 50 KVA, 2400/4160Y to 120/240 volts, single phase, 60-cycle, with cover mounted high voltage bushings

Type A Distribution Transformer, 75 KVA, 2400/4160Y to 120/240 volts, single phase, 60-cycle, with cover mounted high voltage bushings.

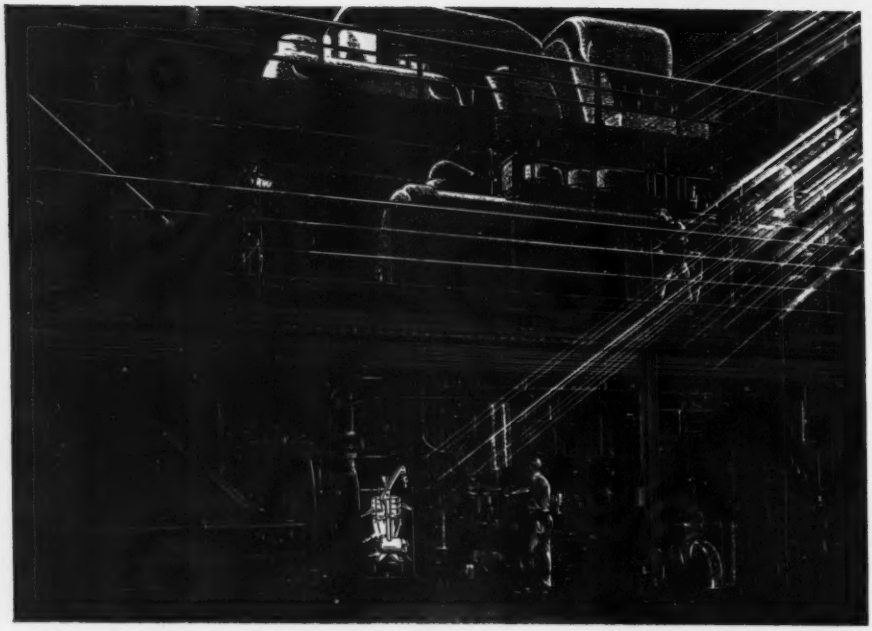
*Oil filled transformers *now* supplied with INHIBITED OIL

Write for Bulletins covering the complete Standard line.

THE STANDARD TRANSFORMER CO.

WARREN • • • OHIO

(REPRESENTATIVES IN PRINCIPAL CITIES)

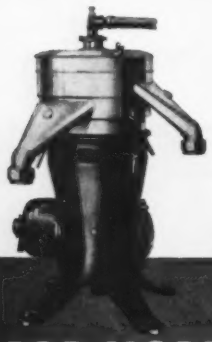


EMPHASIS ON *PROTECTION!*

A De Laval Oil Purifier keeps turbine oil as safely clean as it was the day it was delivered by the refiner. It costs only a fraction of the cost of the power units it protects, and this cost is far outweighed by even one serious shutdown due to oil becoming contaminated.

A De Laval Oil Purifier instantaneously removes from lubricating oil all water, dirt or sludge. By most effectively utilizing centrifugal force it keeps turbine oil so clean that it can be used indefinitely. As the operation is wholly mechanical, everything harmful to the oil is thrown out, but valuable oxidation inhibitors added by the refiner are retained even after thousands of hours of continuous purification.

There is a wide range of sizes to accommodate the capacity requirements of plants of all sizes.



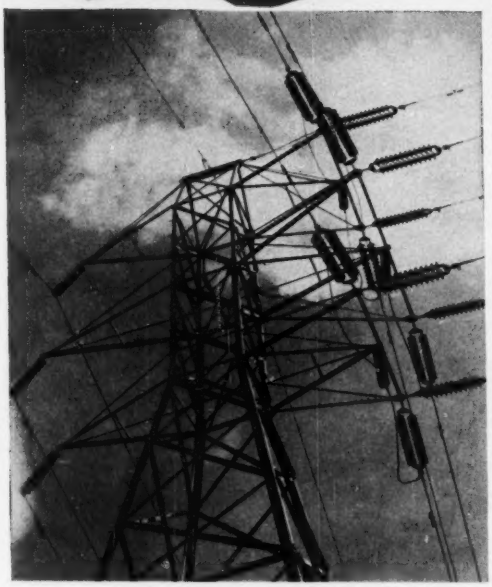
The installation pictured above is in one of the great central stations of the East. It is described in the De Laval Centrifugal Review, Volume 16, No. 1. Sent free on request. *Write for a copy.*

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL
OIL PURIFIERS
FOR MORE DEPENDABLE POWER PRODUCTION

Demand proof OF PERFORMANCE

for Superior Insulator Quality



5000 Thomas Insulators make certain that this new 132-kv, 14-mile line will give satisfactory service for decades to come.

● All insulators are not alike. And Thomas believes that "Repeat Orders" are the best proof of superior insulator quality.

On this page are shown two recent installations of Thomas Insulators by one of the largest Utilities in the Country. For over 35 years, this Customer has given us order after order. Such *repeat orders* from this and other companies, are the best testimonials to the long life and outstanding performance of Thomas Insulators.

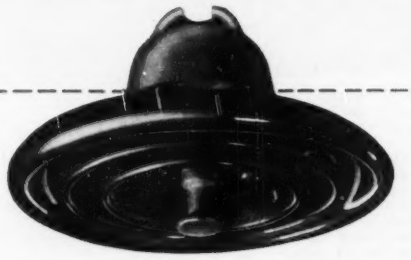
After all is said . . . it's still quality that counts plus proper designing, precision manufacturing . . . and PROOF OF PERFORMANCE. Throughout the world, Thomas Insulators have been establishing service records since the advent of the Electrical Industry. Why gamble?

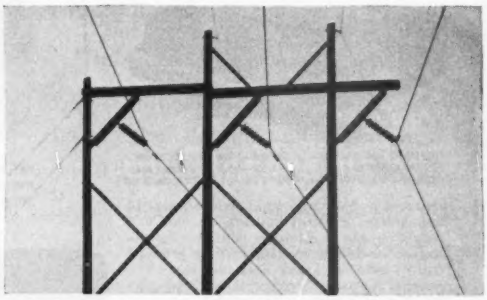
* * *

The R. Thomas and Sons Company is a manufacturer and designer of all types of porcelain insulators . . . pin-type, switch, suspension, spools, guy-strain, bushings and special high-voltage porcelain. In addition, Thomas supplies associated line hardware, clamps, fittings, preformed armor rods, and so on.

SPECIFY THOMAS INSULATORS—THE BEST BY LINE TEST

— Since 1873 —





Angle tower of new 132-kv Eastern line. Thomas Insulators installed on this line have the rugged stamina that assures long life and trouble-free performance.

The R. Thomas and Sons Co.

LISBON, OHIO

NEW YORK CHICAGO

1873 THOMAS INSULATORS our 78th year RELIABILITY 1951

Sales Representatives: E. B. Anderson Co., *Detroit* • Paul Berry, *Oklahoma City* • Ken H. Best, *Seattle* • Butler & Land, *Dallas* • R. E. Cunningham & Son, *Los Angeles* • Electric Supply Co., *Albuquerque* • Engineer Sales Corp., *St. Petersburg* • R. F. Hamilton & Associates, *Denver* • R. H. Harper, *St. Louis* • Geo. E. Hann Company, *San Francisco* • W. J. Hugo, *Minneapolis* • Leiser & Company, *Philadelphia* • Lynn Elliott Company, *Houston* • W. C. Milburn, *Chattanooga* • John G. Pettijohn Company, *Knoxville* • H. E. Ransford Co., *Pittsburgh* • Redmond Supply Co., *Phoenix* • J. F. Schaefer & Co., *Kansas City* • R. J. Sullivan & Company, *Boston* • Walter E. Thompson, *Birmingham* • E. E. Torkell, *Memphis* • Triangle Electric Supply Company, *El Paso* • United Electric Supply Co., *Salt Lake City* • Joe Williams, *Little Rock* • *Representatives in other principal cities*

WHY INDUSTRY CHOOSES... Leader

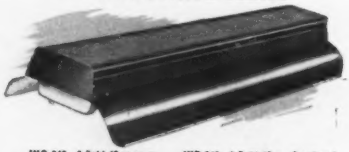
6 REASONS why architects, contractors, business executives specify LEADER Industrial Fluorescent Fixtures

What are they?

● A unit for every lighting job! ● Easy servicing! ● Versatility in mounting! ● Flexibility of installation! ● Precision construction! ● Finest quality materials used throughout!

In addition, Leader brings you an unusually wide variety of 40-watt, 100-watt or Slimline units, available in lengths from 48" to 96", with sturdily constructed, accessible channels. Leader also features such refinements as removable reflectors with captive latch, time-saving turret-type sockets with spring-pressure grip, easy yet rigid end-to-end coupling for optional continuous run installations.

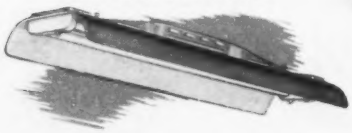
STRATOLINER SERIES



100-248—2-light 48-w. open
100-348—3-light 48-w. open
100-2-198—2-light 100-w. open
10P-248—2-light 48-w. closed end
10P-348—3-light 48-w. closed end
10P-2-198—2-light 100-w. closed end

Durable and strongly built fixtures, neat in appearance. All-steel housing, channel and reflectors. On continuous run wireway installations 2-light sections may be grouped with 3-light or blank sections. One-piece channel for twin 40-watt sections (8' length) or 100-watt sections (10' length).

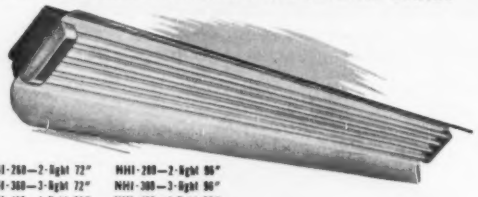
ZEPHYRLITE SERIES



Z00-248—2-light 48-w. open
Z00-348—3-light 48-w. open
Z10-248—2-light 48-w. closed end
Z10-348—3-light 48-w. closed end

Corrugation incorporates unusual strength and rigidity into units. No warping, twisting or sagging! All-steel housing, reflectors, deep drawn channel. 2-light units can be easily converted to 3-light whenever desired. For individual or continuous run wireway installation.

NEW HORIZON SLIMLINE INDUSTRIAL SERIES



NHI-260—2-light 72"
NHI-360—3-light 72"
NHI-460—4-light 72"
NHI-280—2-light 96"
NHI-380—3-light 96"
NHI-480—4-light 96"

These heavy-duty Slimline fixtures bring streamlined styling to industrial lighting and provide exceptionally high light intensity. All-steel channel and reflectors. Designed primarily for continuous run wireway installations. Instant-start operation in choice of 120, 200, 300 or 425 ma. Multi-bulb units for up to 10 lamps available on special order.

Leader

Sold and installed by better electrical dealers and contractors everywhere.

America's No. 1 Lighting Equipment Manufacturer

LEADER ELECTRIC COMPANY

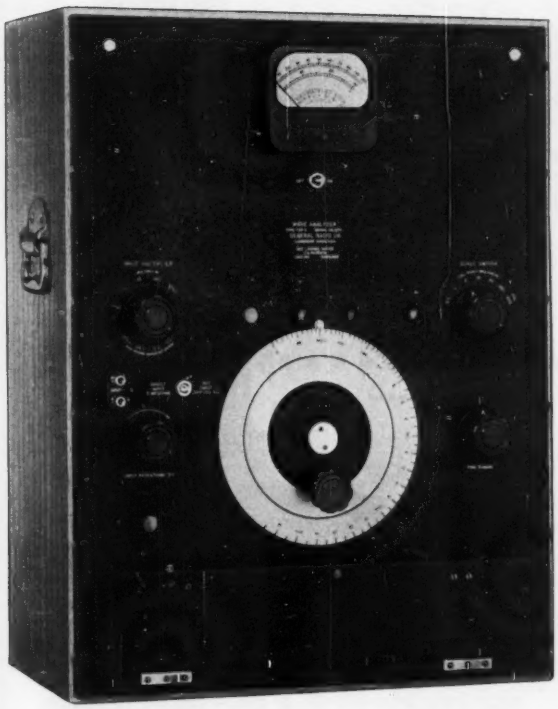
3500 North Kedzie Avenue • Chicago 18, Illinois

Leader Electric—Western: 800 One Hundredth Avenue • Oakland 3, California

Campbell-Leader, Ltd.: Brantford, Ontario • Canada

Input Voltage range:

1,000,000 to 1



Type 736-A WAVE ANALYZER $1075

Specifications

★ **FREQUENCY RANGE:** 20 to 16,000 cycles.
★ **SELECTIVITY:** About 4 cycles flat-top band width. Response is down 15 db at 5 cycles, 30 db at 10 cycles, 60 db at 30 cycles from peak.
★ **VOLTAGE RANGE:** 300 microvolts to 300 volts full scale. Over-all range is divided into four major ranges, each of which is divided into seven scale ranges.
★ **VOLTAGE ACCURACY:** Within ± 5% on all ranges.
★ **HUM:** Suppressed by at least 75 db.
★ **INPUT IMPEDANCE:** 1 meg ohm for direct voltage measurements; 100,000 ohms with input potentiometer.
★ **ACCURACY OF FREQUENCY CALIBRATION:** ± (2% + 1 cycle).
★ **BUILT-IN CALIBRATORS:** For both voltage and frequency.

This analyzer offers the simplest, most accurate and most direct method of measuring the amplitude and frequency of the components of any complex electrical waveform.

In its essentials it consists of a heterodyne-type vacuum-tube voltmeter with a highly selective i-f filter using three quartz bars. At only 60 cycles from resonance the attenuation is down by 75 decibels, yet tuning is very easy by virtue of the 4-cycle flat-top characteristic at resonance. Standards for both voltage and frequency are built into the analyzer and can be used to check its calibration at any time.

The Type 736-A Wave Analyzer is ideally suited for hundreds of types of harmonic-distortion measurements on any type of audio apparatus, broadcast receivers and transmitters, telephone and public address systems, oscillators, amplifiers and other vacuum-tube circuits; hum measurements on a-c operated communications equipment; harmonic induction studies on telephone lines.

WRITE FOR COMPLETE DATA

GENERAL RADIO COMPANY Cambridge 39, Massachusetts

90 West St., New York 6 920 S. Michigan Ave., Chicago 5 1000 N. Seward St., Los Angeles 38

Pennsylvania

...an important name in transformers

Sound management, thorough knowledge of the product, and good workmanship combine to make Pennsylvania Transformer Company an important Name in the transformer industry.

The trust placed in the Pennsylvania product is emphasized by the fact that orders for 60,000, 70,000, and 100,000 Kva transformers are now being filled in Pennsylvania's modern plant.

A special planning department, which devotes all of its time to research and development work, has introduced many fundamental transformer improvements. These include the Pole Star Distribution Transformer, the Standard Parts Power Transformer, the Straight Line Tap Changer, Precompressed Helical and Pancake Coils; and Pennsylite, a new laminated low loss material for terminal boards in underload tap changing equipment.

Pennsylvania TRANSFORMERS

Pennsylvania TRANSFORMER COMPANY

CANONSBURG, PA. *Greater Pittsburgh District*

DISTRIBUTION

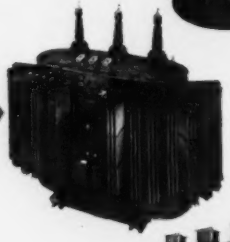
3 Kva to 500 Kva, Up to 66,000 Volts

50 Kva, single phase, 2400-120/240 Volts

POWER

667 Kva to 100,000 Kva, Up to 230,000 Volts

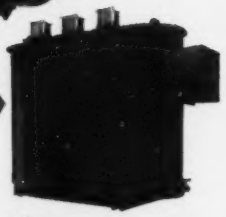
35,000 Kva, 3 phase, 115,000Y - 13200 Δ Volts



FURNACE

All Kva sizes and current ratings

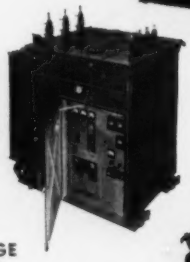
15000 Kva with motor-operated tap changer



INTEGRAL UNIT SUB-STATIONS

Single circuit and double ended unit substations

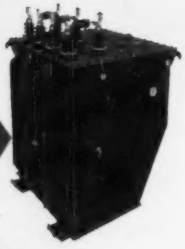
1500 Kva single circuit unit substation



STEP VOLTAGE REGULATORS

Up to 750 Kva for plus or minus 10% regulation in 32 steps

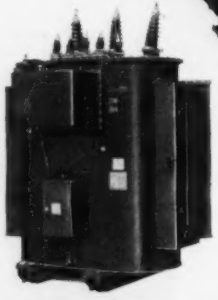
300 Kva, 13800 volts, 32-5/8% taps



LOAD RATIO CONTROL TRANSFORMERS

For changing transformer taps under load.

2500 Kva, 3 phase, 66000-2500/4330Y X7500/12990Y Volts



LOCKE

presents masterpieces of
insulator engineering

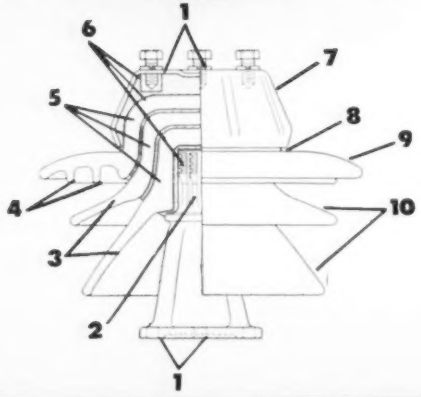
Switch to
LOCKE SWITCH & BUS INSULATORS
typified by

No. 7785

shown above . . . and first introduced by Locke in 1920 as the worthy successor to the industry's first high voltage switch-type insulator . . . originated by Locke in 1911. Today No. 7785 is probably the best known of Locke's large family of Switch & Bus Insulators . . . every member of which you'll find is a masterpiece of engineering in its own right. Always specify them.

Presenting **A MASTERPIECE OF INSULATOR ENGINEERING**

The LOCKE high voltage Switch Insulator



LOCKE DESIGN gives you ALL these advantages

1. Precision assembly jigs maintain positive alignment between tapped holes in the cap and bolt holes in the pin (or base). The top of the cap and bottom of the pin are parallel to within .015-inches. Such accuracy means easy assembly of switches or other apparatus mounted on them.

2. Vertical ribs on the inside of the caps and the outside of the pins provide high torsional strengths.

3. The Locke wet-process porcelain body—the toughest known—has been a standard of comparison since 1893. It is fully capable of withstanding power arcs, lightning flashovers and extremely rough handling.

4. The contours of the corrugations are such as to give maximum resistance to mechanical impact consistent with total weight and balanced electrical characteristics. The depth of the corrugations assure full leakage distance.

5. Locke Compression Sand at the cement joints adds to strength, and the stability of that strength, throughout the life of the insulator.

6. Non-hardening, resilient coatings, applied to all unsanded, load-carrying surfaces, distribute loading efficiently and act as expansion joints under temperature changes. This contributes to longer life.

7. Galvanizing is done by the exclusive Locke Permazinc process—a quality-controlled, double hot-dip method that assures the highest degree of resistance to weathering and corrosion.

8. In assembly the lower edge of the cap is held positively away from the porcelain. This provides an expansion joint which prevents thermal changes from causing high internal stresses in the insulator.

9. Compression Glaze—a Locke development—assures high resistance to damage from thermal shock or mechanical impact. This means that Locke insulators can be handled faster in construction without danger of chipping or breaking.

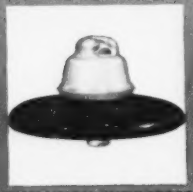
10. The uniformly smooth glazed surface assures easy natural cleaning by wind and rain, and aids the insulator in maintaining its originally excellent electrical characteristics.

YOU ARE EQUALLY SURE of masterpieces of design when you specify other products in the complete line of Locke Insulators and Suspension Hardware. Each pays off in superior performance on transmission and distribution lines, generating stations, sub-station and electrical apparatus.

LOCKE
INCORPORATED
BALTIMORE • MARYLAND

LOW VOLTAGE PIN TYPE INSULATORS

HIGH VOLTAGE PIN TYPE INSULATORS


SUSPENSION INSULATORS

SWITCH & BUS INSULATORS

SPOOL INSULATORS

GUY INSULATORS

LIQUID-FILLED BUSHINGS

SUSPENSION & STRAIN CLAMPS

SUSPENSION HARDWARE

ENTRANCE BUSHINGS

New 1951 CHEVROLET TRUCKS

Better before...now better than ever

America's best truck investment is an even better one for '51! Yes, this latest line of Advance-Design trucks combines the greatest of Chevrolet's traditional advantages with new features and improvements that make your dollars go farther than ever! Along with outstanding power and economy, finest construction and superior handling ease, Chevrolet Advance-Design trucks offer new, improved-design brakes, new Ventipanes, and Chevrolet's new cab seats—plus a host of other features that mean increased value to owners. See your Chevrolet dealer and look over this new line of 1951 Chevrolet trucks today. They're "best buys" every one!

CHEVROLET MOTOR DIVISION *General Motors Corporation* DETROIT 2, MICHIGAN

CHEVROLET

ADVANCE-DESIGN TRUCK FEATURES

TWO GREAT VALVE-IN-HEAD ENGINES—the 105-h.p. Loadmaster or the 92-h.p. Thriftmaster—to give you greater power per gallon, lower cost per load • POWER-JET CARBURETOR—for smooth, quick acceleration response • DIAPHRAGM SPRING CLUTCH—for easy-action engagement • SYNCHRO-MESH TRANSMISSIONS—for fast, smooth shifting • HYPOID REAR AXLES—for dependability and long life • NEW TORQUE-ACTION BRAKES—for light-duty models • PROVED DEPENDABLE DOUBLE-ARTICULATED BRAKES—for medium-duty models • NEW TWIN-ACTION REAR BRAKES—for heavy-duty models • NEW DUAL-SHOE PARKING BRAKE—for greater holding ability on heavy-duty models • NEW CAB SEATS—for complete riding comfort • NEW VENTIPANES—for improved cab ventilation • WIDE-BASE WHEELS—for increased tire mileage • BALL-TYPE STEERING—for easier handling • UNIT-DESIGN BODIES—for greater load protection • ADVANCE-DESIGN STYLING—for increased comfort and modern appearance.

Specify ACCURATE TAPES

—for every wiring need!

ACCURATE FRICTION TAPE

Features the best of material carefully fabricated to provide maximum mechanical protection. Available in Standard and A.S.T.M. grades.

ACCURATE RUBBER TAPE

Offers high elasticity, high dielectric strength and super aging qualities. Made in both Standard grade and A.S.T.M. – A.A.R. Specification

ACCURATE PLASTIC TAPE

Thin caliper plus a combination of good mechanical and dielectric strengths. Recommended for use wherever plastic tape is practical.

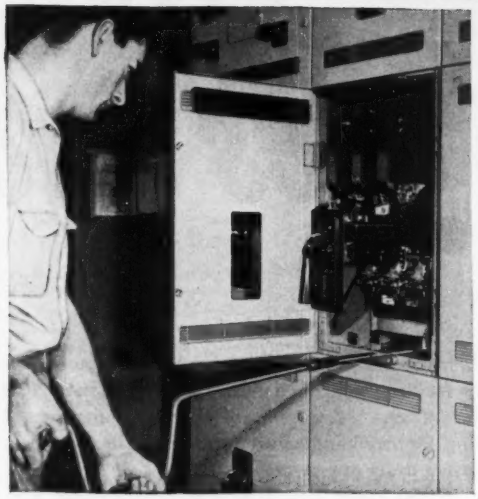
MEMO TO
electrical men!
It's easier and faster with ACCURATE TAPES
Best from all angles — that's Accurate tape. Faster applying because of super workability and cohesion. No heat or pressure, required for Accurate Rubber Tape, either. Try Accurate on your next job.

ACCURATE TAPES for the electrical industry are manufactured to precision standards by men who have devoted a lifetime to producing tapes of superior quality. Every foot is carefully made and constantly inspected to assure uniform high quality. The sure way to complete tape satisfaction is to specify ACCURATE by name — every time. Get all the facts on ACCURATE Tape now! Just call or write the Accurate Manufacturing Company, Garfield, New Jersey, for new illustrated literature which includes complete specifications and technical data covering the entire ACCURATE line of quality tapes. There is no obligation.

ACCURATE your best buy in tape

MORE THAN A QUARTER CENTURY OF TAPE SPECIALIZATION

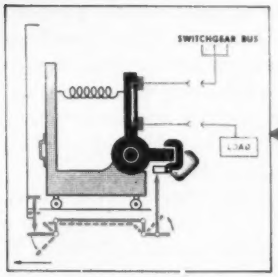
I-T-E SWITCHGEAR GIVES YOU *DOUBLE PROTECTION*



Have you ever considered the results of a sudden loss of power in your plant—lights going out, machines stopping, possible injury to personnel? It could be a trying and costly experience, particularly if it could easily have been prevented!

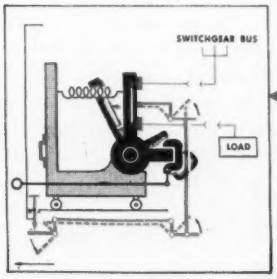
The purpose of your switchboard is to minimize power shutdowns and protect equipment and personnel. I-T-E switchboards do these things and much more. They offer you *double protection*—because mechanical interlocks of a design unique with I-T-E protect the drawout circuit breakers which in turn protect your power distribution system.

A mechanical interlock prevents the circuit breaker from being connected to or disconnected from line and load connections *unless the breaker's contacts are open.* If this is not accomplished, withdrawal of the circuit breaker would cause arcing at the disconnect device, probable subsequent damage to the equipment, power loss and injury to personnel.



The interlock by "deduction"

The ordinary interlock works by "deduction"; that is, movement of the interlock's mechanical linkages disengages the latch which holds the breaker in a closed position. The breaker's contacts *should* then be open, but the breaker may then be moved in or out whether or not the contacts are actually open.



The interlock by I-T-E

On the other hand, I-T-E's interlock is safe, sure, simple. This interlock mechanism is connected directly to the arm which carries the movable contacts. Unless the breaker has been fully opened by a separate manual tripping action, it *cannot* be moved into or out of line and load engagement.

The I-T-E interlock is a simple but important feature. Your operator's life and your plant's safety may depend on it. It's just one more reason why *I-T-E is your best switchgear buy!*

For more information about I-T-E Multumite Switchgear, send for bulletins 6003-D and 7000-A.

For *more dependable* Switchgear

specify I-T-E!

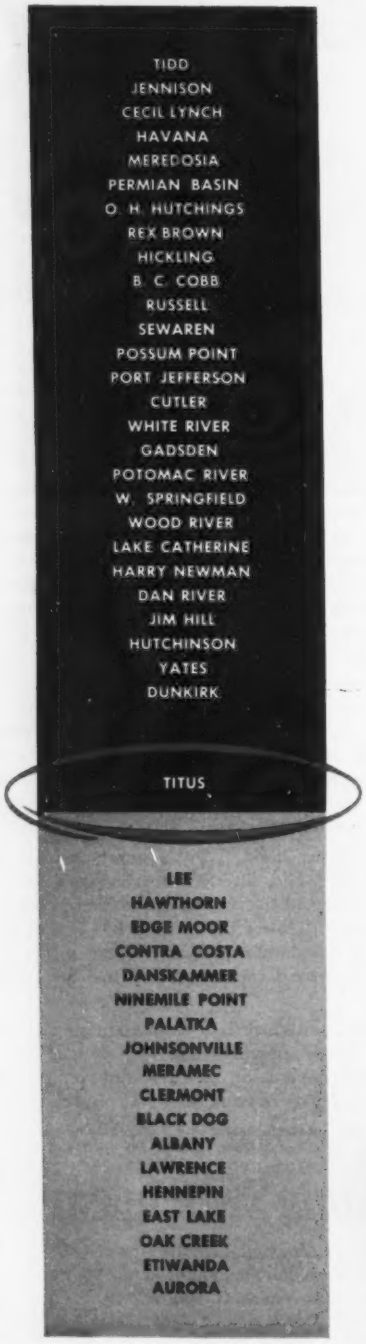
I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Philadelphia 30, Pa.

Power Switching Equipment: Railway and Industrial Engineering Co., Greensburg, Pa.
Canadian Mfg. & Sales: Eastern Power Devices, Ltd., Toronto • Export Sales: Philips Export Corp., New York

SWITCHGEAR • UNIT SUBSTATIONS • ISOLATED PHASE BUS STRUCTURES • CIRCUIT BREAKERS • MECHANICAL RECTIFIERS • RESISTORS • SPECIAL PRODUCTS

NEW UTILITY STATIONS C-E EQUIPPED

Includes stations placed in operation since the war (in white) and those under construction or being engineered.



New goes into

Another important addition to the nation's power generating facilities was made recently when the new Titus Station of the Metropolitan Edison Company of Reading, Pennsylvania, placed the first of its three new generating units in service.

Its 75,000 kw of new electrical capacity was welcomed to meet rapidly growing power needs of this "Key Area of the Keystone State." A second unit will be ready for service in about three months, and a third unit is scheduled for completion early in 1953. Engineering design and construction of this 225,000 kw plant is under the direction of Gilbert Associates, Inc., Reading, Pennsylvania.

Existing 114,000 volt transmission lines make it possible to utilize Titus Station power throughout the 14 counties served by MECO. The plant is also interconnected with other utility companies through a transmission system extending from Newark, New Jersey, to Erie, Pennsylvania.

Steam for the unit now in service is supplied by a C-E Steam Generating Unit of the reheat type, employing a single-boiler, single-turbine arrangement. The units now under construction are duplicates. A cross-sectional elevation and brief description of one of the steam generators is shown on the opposite page. B-459

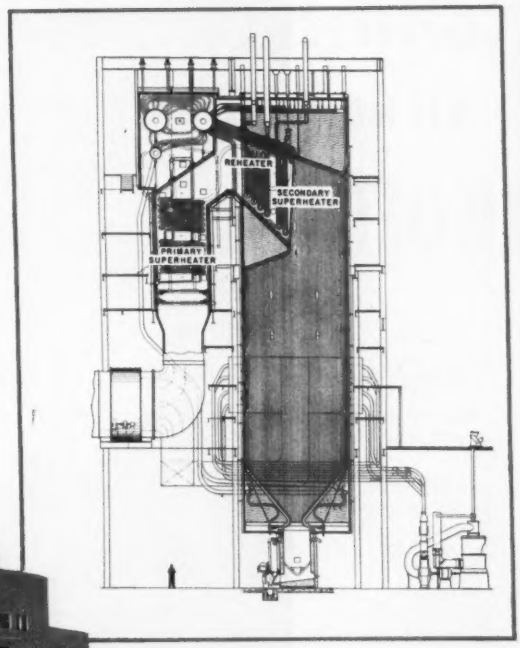
C-E

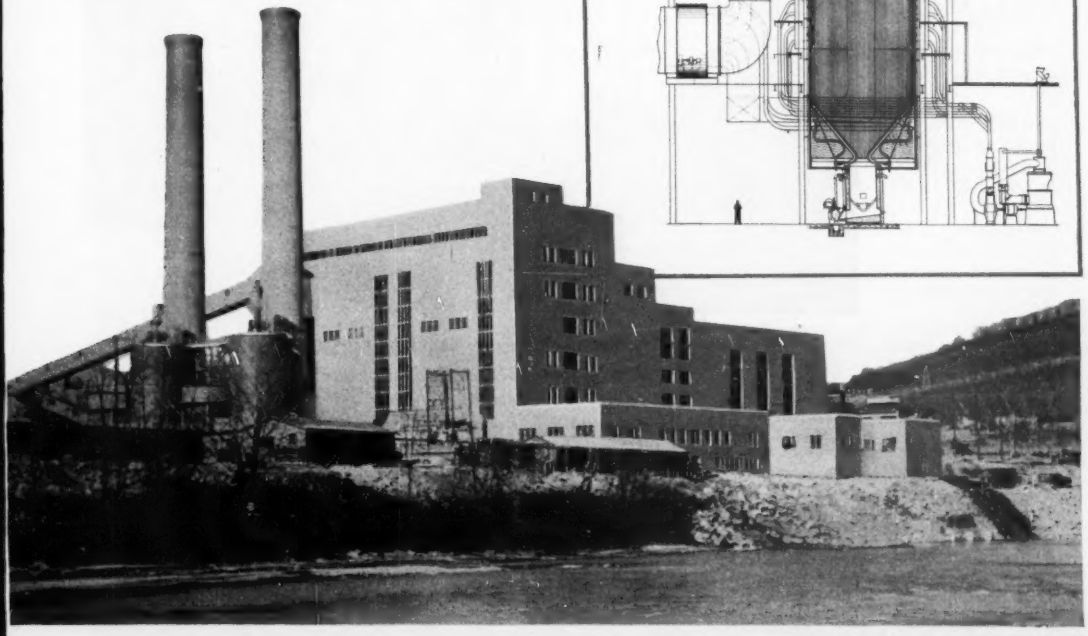
COMBUSTION

200 MADISON AVENUE, NEW YORK 16, N. Y.

Titus Station service

The cross-sectional view at the right shows the C-E Unit now in service at the Titus Station. Two duplicate units are presently under construction. They are reheat units of the radiant type with a reheater section located between the primary and secondary superheater surface. A finned tube economizer is located below the rear superheater section. Regenerative air heaters follow the economizer surface. These units are pulverized coal fired, using bowl mills and tilting, tangential burners. Steam is supplied to the turbines at 1450 psi at a temperature of 1000 F, reheated to 1000 F.

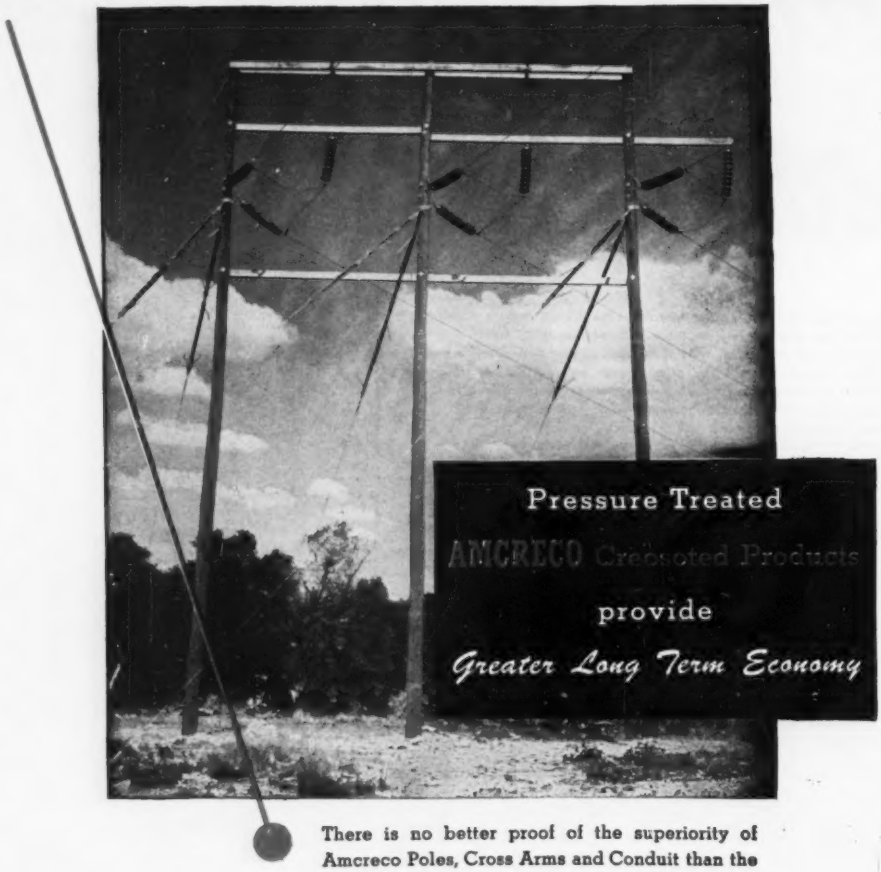




ENGINEERING—SUPERHEATER, INC.

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

THE PROOF *is in the service records!*



There is no better proof of the superiority of Amcreco Poles, Cross Arms and Conduit than the actual service records. It is the best indication of the long pole life and freedom from maintenance troubles for users of Amcreco. We will be pleased to show you typical service records and point out how Amcreco can reduce your cost per pole per year. Write today.

Amcreco
Lowry Process
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AMERICAN CREOSOTING COMPANY
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LOUISVILLE, KENTUCKY

COLONIAL CREOSOTING COMPANY INCORPORATED
AMCREO LOWRY PROCESS CREOSOTED PRODUCTS
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POLES • CROSS ARMS • CONDUIT

CORNELL-DUBILIER CAPACITORS
FOR POWER-FACTOR IMPROVEMENT

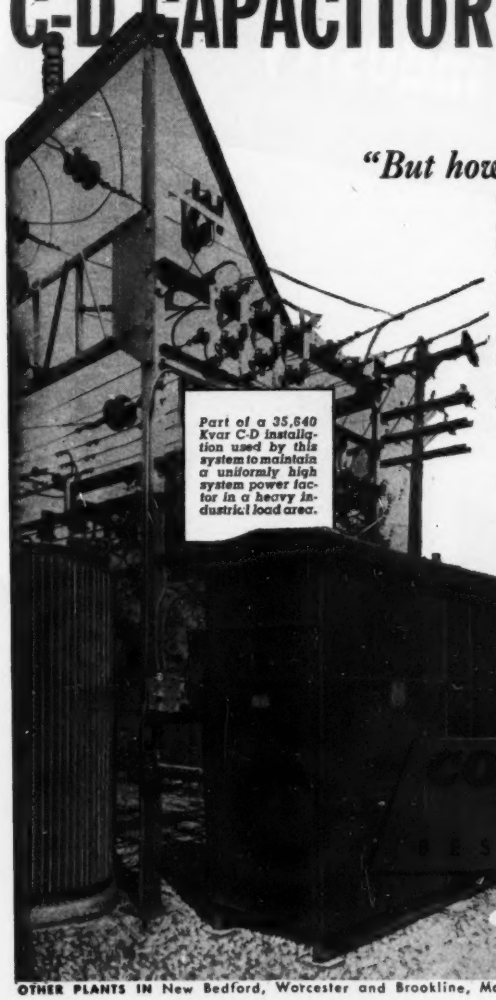
40TH ANNIVERSARY CORNELL-DUBILIER CAPACITORS 1910-1951

Detroit Utility reports:

OVER 1½ BILLION KVAR HRS.

OF 99.1% TROUBLE-FREE OPERATION from its

C-D CAPACITOR INSTALLATION!



Part of a 35,640 Kvar C-D installation used by this system to maintain a uniformly high system power factor in a heavy industrial load area.

"But how does it stand up in the field?"

There's only one way to get the answer — not from a blue-print, not from a lab report, but from actual, time-tested installations *in* the field!

You need *facts* like these: "Detroit Utility reports that its Cornell-Dubilier capacitors have delivered 1,863,952,800 Kvar/hrs. of 99.1% trouble-free operation to date". A field performance record for unmatched dependability!

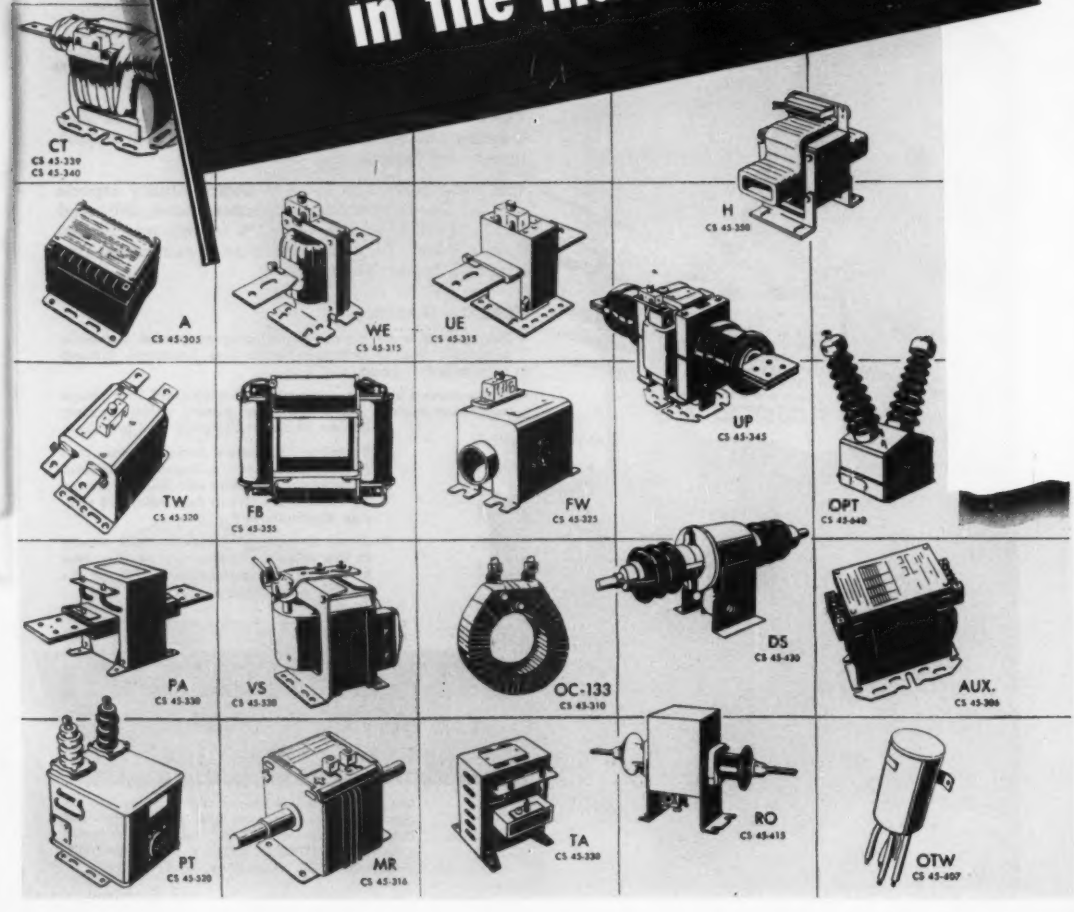
MORE C-D FEATURES:

- **Heavy-duty, multi-petticoat, wet-process, glazed porcelain bushings. Longer creepage path; less breakage hazard; high impulse rating.**
- **Wrap-around bracket — another C-D exclusive! Two wraps extending around sides affording greater safety against impact stress in shipping and handling.**
- **Terminal discharge resistor connected to each series section, instead of terminal to terminal. Provides effective discharge for each series group and balanced voltage distribution.**
- **Small sections in series-parallel results in low voltage gradient per section; less heating; lower power-factor; lowest dielectric unit stress.**

Our engineers will be glad to show you why long life and dependable service are built-in characteristics of Cornell-Dubilier capacitors. Catalog on request. CORNELL-DUBILIER ELECTRIC CORPORATION, Department D-21, South Plainfield, New Jersey.

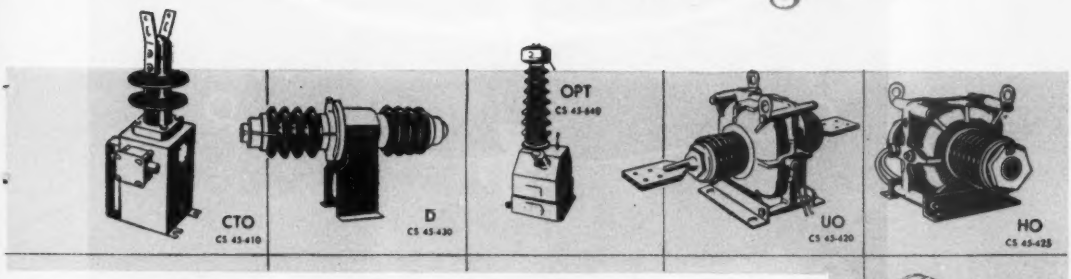
OTHER PLANTS IN New Bedford, Worcester and Brookline, Mass.; Providence, R. I.; Indianapolis, Ind., and Cleveland, Ohio.

The most complete line of Instrument Transformers in the industry



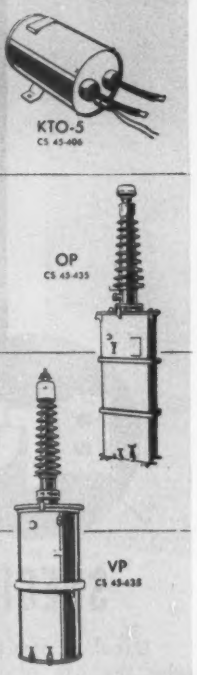
YOU CAN BE **SURE**.. IF IT'S

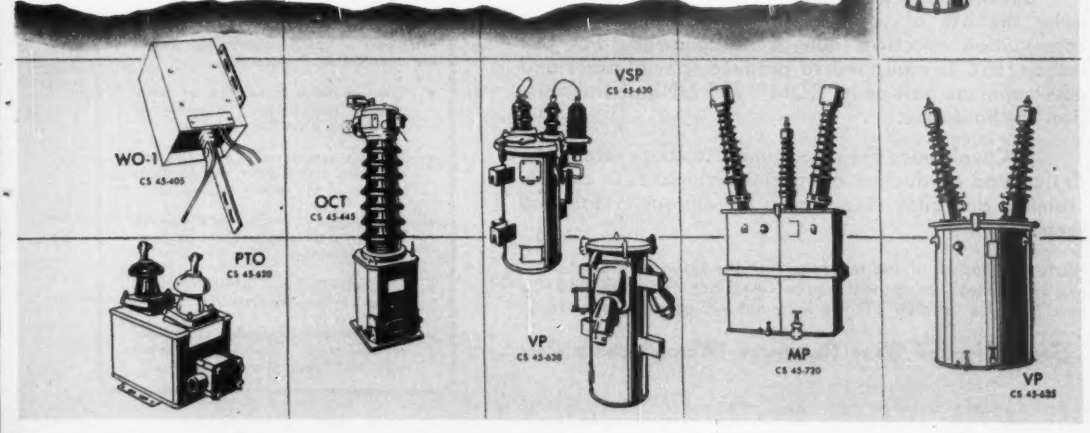
Westinghouse

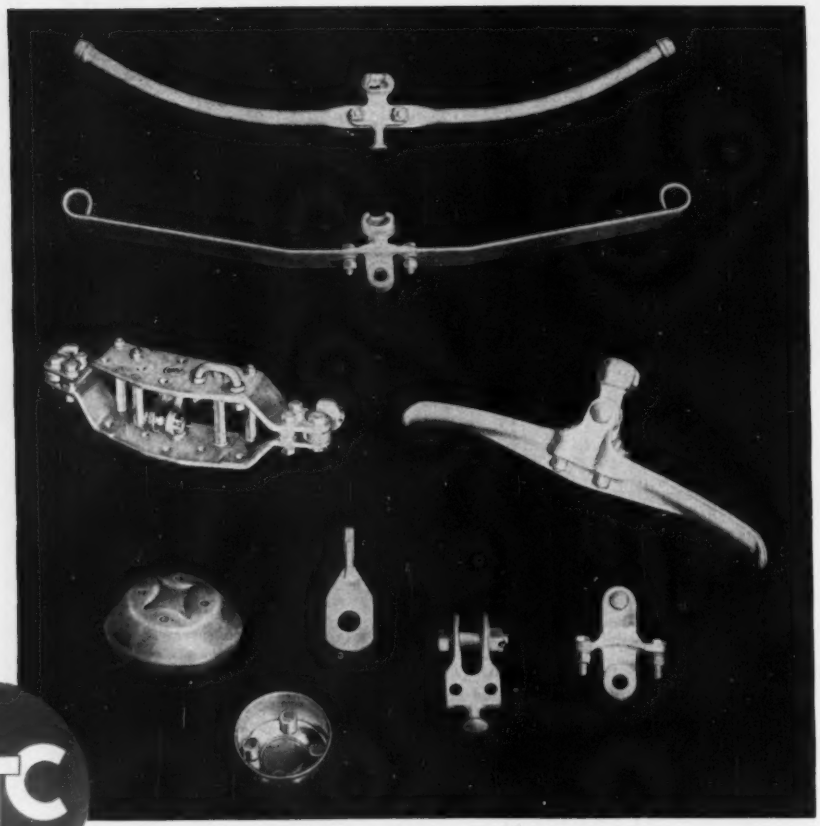


Solve all your instrument transformer problems quickly, easily! Turn to the Westinghouse salesman. He has the most complete line in the industry . . . for metering, relaying, current, potential or auxiliary applications. For further information on any of the transformers illustrated, contact your nearest Westinghouse office, or write for Catalog Sections by listing the "CS" numbers desired. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-70573

Westinghouse
INSTRUMENT TRANSFORMERS







BTC

. . . the Complete Line

SPECIAL TRANSMISSION LINE HARDWARE

Local transmission line conditions sometimes require the use of special equipment where standard construction practices cannot be followed. For this reason, BTC is equipped to produce special parts and assemblies as part of its COMPLETE LINE of transmission line hardware.

BTC welcomes the opportunity to cooperate in the design and production of special assemblies in carbon, stainless and alloy steels, or in non-ferrous metals and their alloys.

Write BTC today, giving full details on the types of special parts and assemblies that you will require. And be sure to request BTC's new "Hi-Line Catalog", if you have not yet obtained your copy.

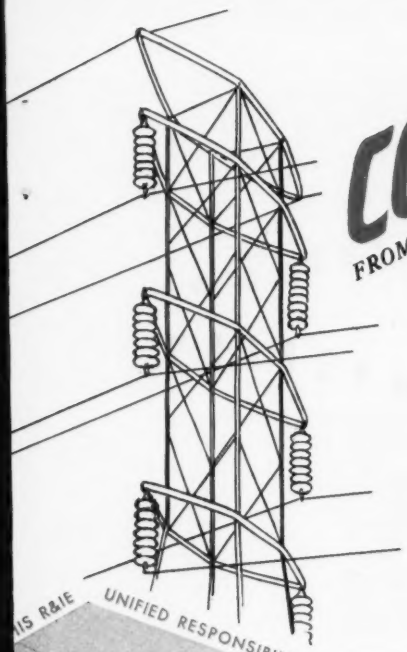
Sold Through Your Insulator Manufacturer Only

THE BREWER-TITCHENER CORPORATION, Cortland, N. Y.

BTC is well qualified to undertake development of special assemblies, offering the transmission engineer:

- Thorough-going knowledge of transmission construction, properties of metals and electrical cables.
- 25 years experience in designing and producing transmission line hardware for most of the important lines.
- Wide range of forging, cold working, welding, machining and hot-galvanizing equipment.
- Adequate facilities for strength and clamp performance tests.
- Personnel with knowledge of new developments in insulator, electrical cable and construction fields.

SUBSTATION AND SWITCHING PROBLEMS



COVERED!

FROM THE LAYOUT TO THE LINE

when you rely on

R&IE

UNIFIED RESPONSIBILITY

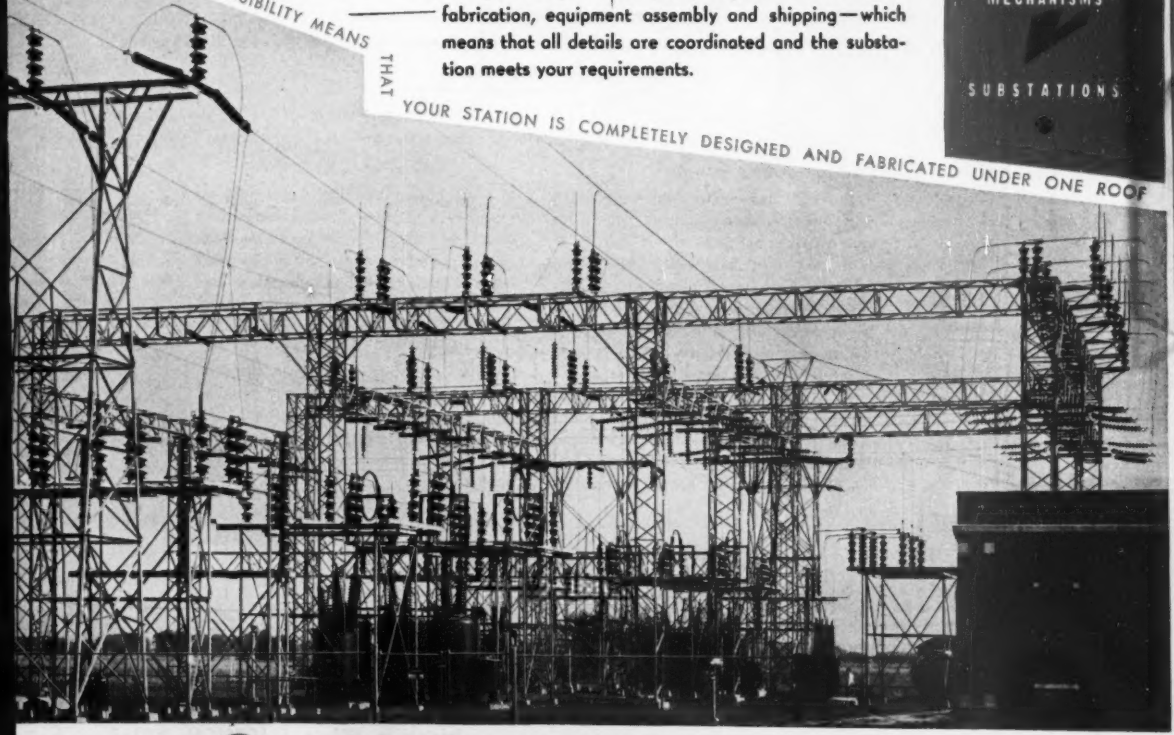
FROM THE LAYOUT TO THE LINE—Substation design and detail arrangements such as shown here are everyday problems with R&IE engineers. For over thirty years R&IE has set the standard in the solution of simple or complex layout requirements.

R&IE UNIFIED RESPONSIBILITY means that your station is easier to order, to check, to change if necessary. Here, "Under one Roof", R&IE controls all fabrication, equipment assembly and shipping—which means that all details are coordinated and the substation meets your requirements.

The Check List

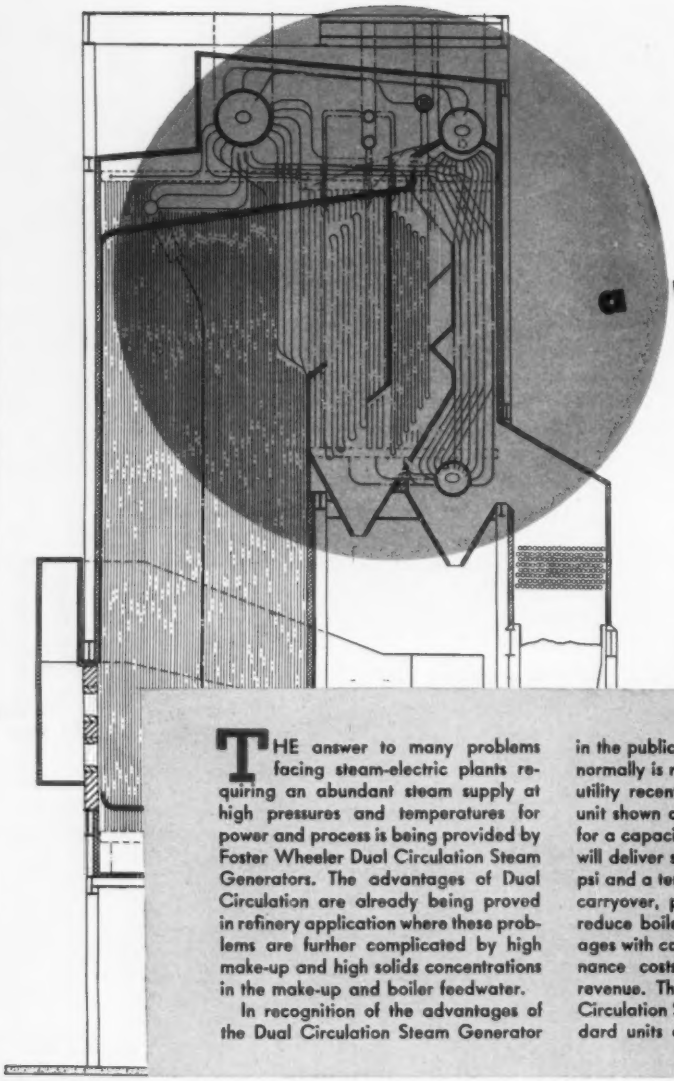
- CONDUCTOR SUPPORTS, CLAMPS AND FITTINGS
- DISCONNECTING SWITCHES INDOOR AND OUTDOOR
- HORN GAP SWITCHES
- INTERRUPTER SWITCHES
- CUTOUTS AND THERMO-RUPTERS
- DISTRIBUTION EQUIPMENT
- SWITCH OPERATING MECHANISMS
- SUBSTATIONS

IS R&IE UNIFIED RESPONSIBILITY MEANS THAT YOUR STATION IS COMPLETELY DESIGNED AND FABRICATED UNDER ONE ROOF



RAILWAY and INDUSTRIAL ENGINEERING CO., Greensburg, Pa.

IN CANADA—EASTERN POWER DEVICES LIMITED, TORONTO



a utility

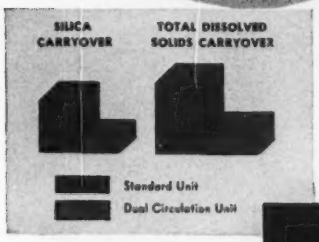
THE answer to many problems facing steam-electric plants requiring an abundant steam supply at high pressures and temperatures for power and process is being provided by Foster Wheeler Dual Circulation Steam Generators. The advantages of Dual Circulation are already being proved in refinery application where these problems are further complicated by high make-up and high solids concentrations in the make-up and boiler feedwater.

In recognition of the advantages of the Dual Circulation Steam Generator in the public utility field where make-up normally is relatively low, a midwestern utility recently ordered the three-drum unit shown above. This unit is designed for a capacity of 425,000 lb per hr and will deliver steam at a pressure of 1350 psi and a temperature of 955 F. The low carryover, previously unattainable, will reduce boiler and turbo-generator outages with consequent savings in maintenance costs and gains in operating revenue. The advantages of the Dual Circulation Steam Generator over standard units are illustrated at the right.

● *Write for a Copy of Bulletin B-50-11*

FOSTER WHEELER CORPORATION 165 BROADWAY NEW YORK 6,

specifies... DUAL CIRCULATION

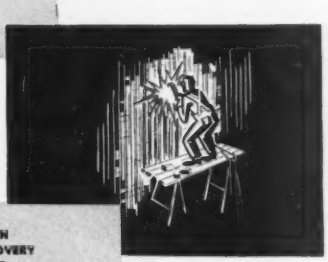


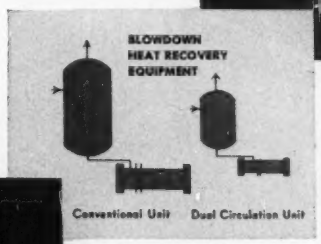
REDUCED CARRYOVER OF

a. Silica
b. Total Dissolved Solids

LOW CONCENTRATION IN HIGH DUTY FURNACE SECTION RESULTING IN

a. Minimum Tube Damage
b. Reduced Maintenance and Outage Time





IMPORTANT SUPPLEMENTARY ADVANTAGES IN CERTAIN APPLICATIONS

a. Reduced Blowdown With Resulting Reduction In Heat Loss and Size of Heat Recovery Equipment

b. Reduced Cost of Chemicals and Equipment For Water Treatment

NEW YORK

FOSTER WHEELER

WHEREVER YOU USE WOOD..

IN FRESH WATER, many preservatives leach out of wood. Barrett* Coal-Tar Creosote resists this leaching action. Being only negligibly soluble in water, it is the preferred preservative for use on submerged wood structures, or those exposed to the powerful action of rapidly flowing water.

IN THE NORTH, poles must resist the tremendous weight of frequent sleet storms. Avoid preservatives which *weaken* the wood. BARRETT Coal-Tar Creosote allows poles to retain their maximum strength, and helps to keep the poles at their best and hold the lines aloft.

IN THE SOUTH, prolonged high temperatures cause light-bodied preservatives to leach and evaporate from the wood, thus exposing the wood to termite attack and decay. BARRETT Coal-Tar Creosote, heavier bodied and of lower volatility, prevents this condition. It stays in the wood longer under all conditions—doesn't "run out" on the job.

IN THE DESERT, crossties broom, shatter and split from extreme dryness and heat. Solutions made with BARRETT Coal-Tar Creosote retard this, and also reduce mechanical wear of crossties through their lubricating action on the wood fibers. In poles, heavy treatment with BARRETT Coal-Tar Creosote substantially reduces checking and splitting.

IN THE SWAMPS, forces of decay are almost at their maximum of destructive power. High moisture content and infection from other decaying wood and debris are ever-present menaces. Poles properly treated with Coal-Tar Creosote have survived under swamp conditions for years.

IN SALT WATER, marine wood-borers give a preservative its severest test. Of hundreds of preservatives that have been tried through the years, *Coal-Tar* Creosote is the only one that has proved consistently effective against teredos, limnoria and other salt-water enemies of wood.

THE BARRETT DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.

Use Barrett* →

*Reg. U. S. Pat. Off.

Only coal-tar creosote wood preservative has been used long enough and widely enough to have proved its effectiveness under all conditions.

COAL TAR CREOSOTE

YOU CAN BE **SURE**.. IF IT'S

Westinghouse

BE SURE about Lightning Protection

Your Capital Investment is at stake!

Buying lightning protection for any application is a serious business. There's a lot at stake; a big investment in equipment . . . and in consumer good will. You've got to be *sure!* And you *can* be sure when you specify Westinghouse.

Westinghouse engineering and design have solved many special problems, such as protection for 500-kv systems. The same research, engineering and manufacturing know-how goes into standard arresters for your everyday needs.

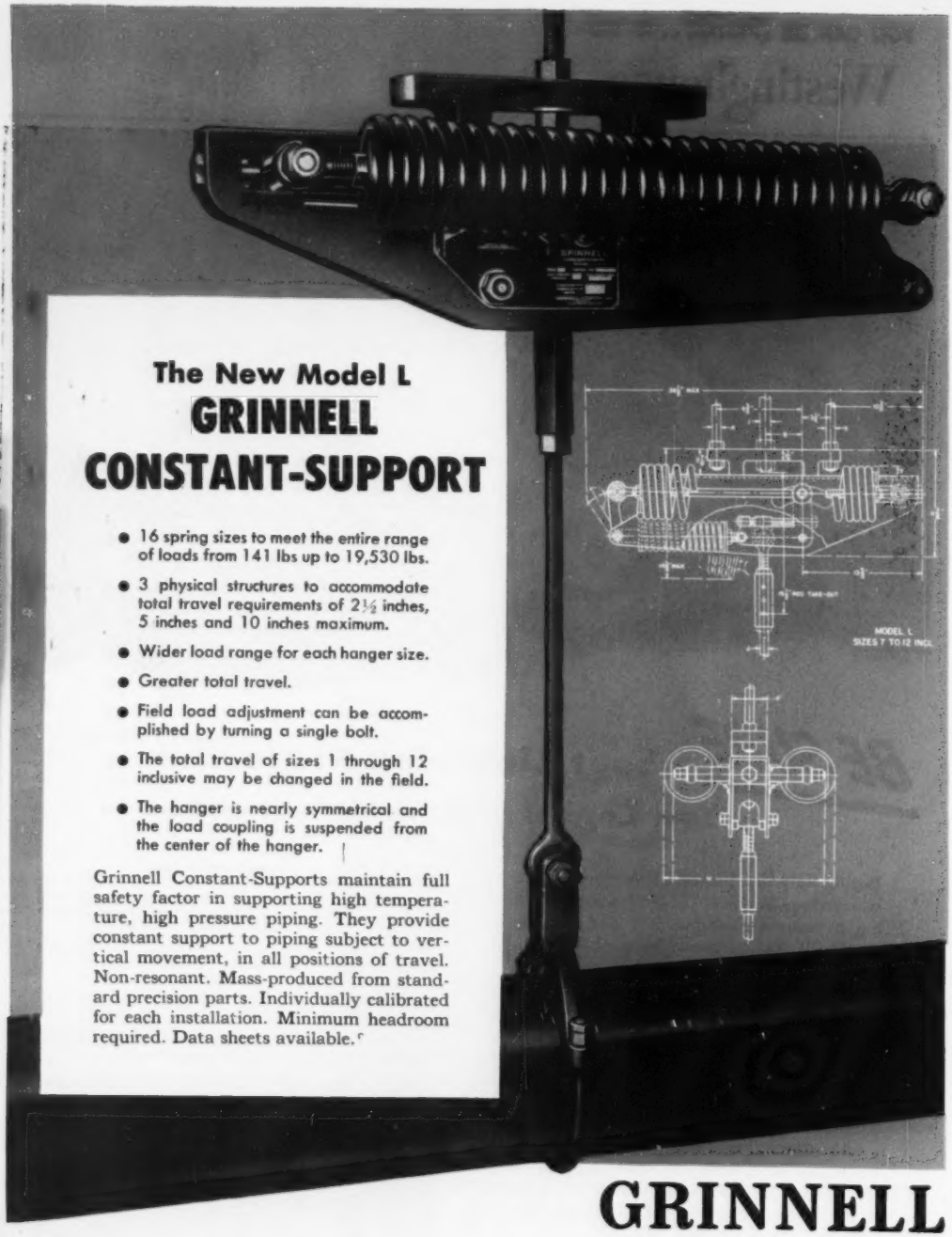
For your special *and* everyday protection problems—whether it's a transmission line . . . a substation . . . or a distribution feeder—it will pay you to be sure. Specify Westinghouse. We'll be glad to help on any lightning protection problem. Simply call your Westinghouse office, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

A COMPLETE LINE

- **Type SV**—for protecting continuity of service and heavy investments in large substations and generating plants at voltages from 3 to 500 kv.
- **Type LVS**—for economical protection of less costly substations at voltages from 20 to 73 kv.
- **Type L "De-ion" Tube**—for protection of transmission lines at voltages from 13.8 to 138 kv.
- **Type LV Autovalve**—for protection of distribution apparatus at voltages from 3 to 15 kv.
- **Type A "De-ion"**—for protection of distribution apparatus at voltages from 3 to 15 kv. J-60725

Westinghouse

LIGHTNING ARRESTERS



The New Model L
GRINNELL
CONSTANT-SUPPORT

- 16 spring sizes to meet the entire range of loads from 141 lbs up to 19,530 lbs.
- 3 physical structures to accommodate total travel requirements of 2½ inches, 5 inches and 10 inches maximum.
- Wider load range for each hanger size.
- Greater total travel.
- Field load adjustment can be accomplished by turning a single bolt.
- The total travel of sizes 1 through 12 inclusive may be changed in the field.
- The hanger is nearly symmetrical and the load coupling is suspended from the center of the hanger.

Grinnell Constant-Supports maintain full safety factor in supporting high temperature, high pressure piping. They provide constant support to piping subject to vertical movement, in all positions of travel. Non-resonant. Mass-produced from standard precision parts. Individually calibrated for each installation. Minimum headroom required. Data sheets available.

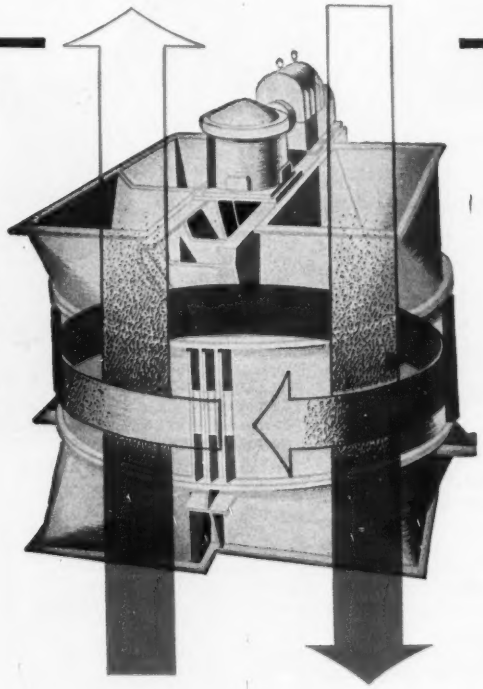
GRINNELL
WHENEVER PIPING IS INVOLVED

GRINNELL COMPANY, INC., Providence, R. I. Warehouses: Atlanta • Billings • Buffalo • Charlotte • Chicago
Cleveland • Cranston • Fresno • Kansas City • Houston • Long Beach • Los Angeles • Milwaukee • Minneapolis • New York
Oakland • Philadelphia • Pocatello • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane

more than 200,000,000 lbs/hr of post-war steam generating capacity

equipped with *Ljungstrom*

AIR PREHEATERS



Here indeed is impressive evidence of the wide acceptance of the Ljungstrom air preheater. Since the war the total capacity of steam generating units equipped with Ljungstrom air preheaters, installed, under construction or on order in industrial and utility plants throughout the country comes to well over 200,000,000 lbs of steam per hr.

The reasons for the steadily increasing preference for the Ljungstrom air preheater are simple enough. The continuous regenerative counterflow principle assures maximum heat transfer with minimum weight and size. Flexible and compact, it may be used in a wide range of applications. Its proven reliability and low maintenance eliminate costly shutdowns.

If you are planning to build a new plant or modernize an old one, investigate the possibilities of the Ljungstrom. The specialized experience of Air Preheater engineers is at your disposal, to aid in effecting the most economic heat recovery from flue gases.

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves the heat is transferred from the waste gases to the incoming cold air.

THE AIR PREHEATER CORPORATION

60 EAST 42d STREET • NEW YORK 17, NEW YORK

You can get more out of your present Distribution Equipment...

Lincoln Type ADS Ampere Demand Meters, mounted on a switchboard at Duquesne Light Company, Pittsburgh, Pa.

LINCOLN Ampere Demand Meters and Indicating Voltmeters

Maximum return from existing distribution equipment results from systematically applied voltage control, and loads balanced between feeders. Simple changes in the system that add up to greater kilowatthour consumption can be effectively made on the basis of continuous voltage information all along your system.

Lincoln Ampere Demand Meters measure the continuous facts needed to help balance the load between phases on feeder lines for most effective use of system and distribution capacity. They show the demand on the feeder phase at all times as well as the maximum demand reached since the last manual resetting.

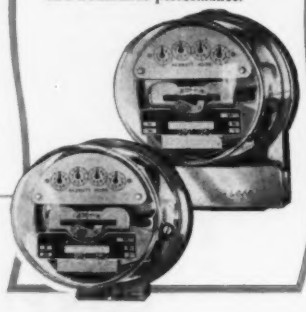
Lincoln MiniMax Indicating Voltmeters permit low-cost, permanent installations that provide continuous information for setting voltage regulators and for solving other voltage control problems while saving the heavy labor costs of periodic surveys.

For most effective results—at the lowest cost—put this winning combination to work on your system. Write for full information today.

Typical outdoor MiniMax Voltmeter installation.

Sangamo J Meters

These watthour meters meet today's requirements and tomorrow's anticipated loads with sustained accuracy, economy of maintenance, and troublefree performance.



Only Measured Facts are Known Facts

SANGAMO ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

MAKE A *Good Connection!*

WEAVER

CAST GROUND ROD CLAMPS

CAST of high strength Aluminum Bronze, WEAVER GROUND ROD CLAMPS withstand great tightening torques without distortion and assure permanent high pressure connections.

They are designed to assure perfect alignment between rod and wire, and the long wire-bearing surface provides exceptionally good contact.

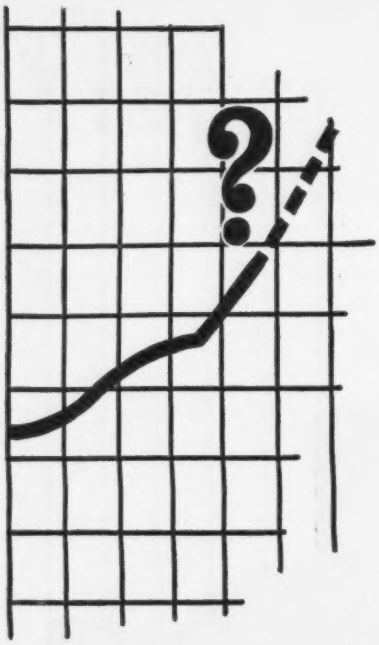
Clamps are provided with either hex head or socket set screws which are specially machined with rounded points to prevent damaging the surface of the Ground Rod.

For top quality at lowest cost, you can't beat WEAVER CAST GROUND ROD CLAMPS.

GROUND ROD CLAMP

Write for the latest Weaver Catalogue

J.A. WEAVER CO.
ST. LOUIS 6, MO.
2110 HOWARD ST. CE. 0881



Where Is

NO ONE KNOWS for sure what the ultimate demand for electrical power will be. Those who predicted 100,000,000 kw capacity for 1956 were looked on as starry-eyed dreamers. Now, there are men who predict 200,000,000 kw or more by 1966.

Huge expansion programs are now in progress to take care of the growing load. Utility men everywhere are showing initiative and foresight in their planning.

Allis-Chalmers is proud of the part it is playing in this expansion, for A-C offers a wide range of major products for the electrical power industry. Whether you are interested in boosting the efficiency of your present plant or adding a new plant, get help from your nearby Allis-Chalmers District Office early in the planning stage, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3299

It Pays to Keep Pace with Machinery Progress

NEW BARREL type boiler feed pump designed especially for higher pressures now common. Pump shown is 5" x 5", 12 stage with capacity of 227,000 lbs per hour (480 gpm) against 1750 psig.

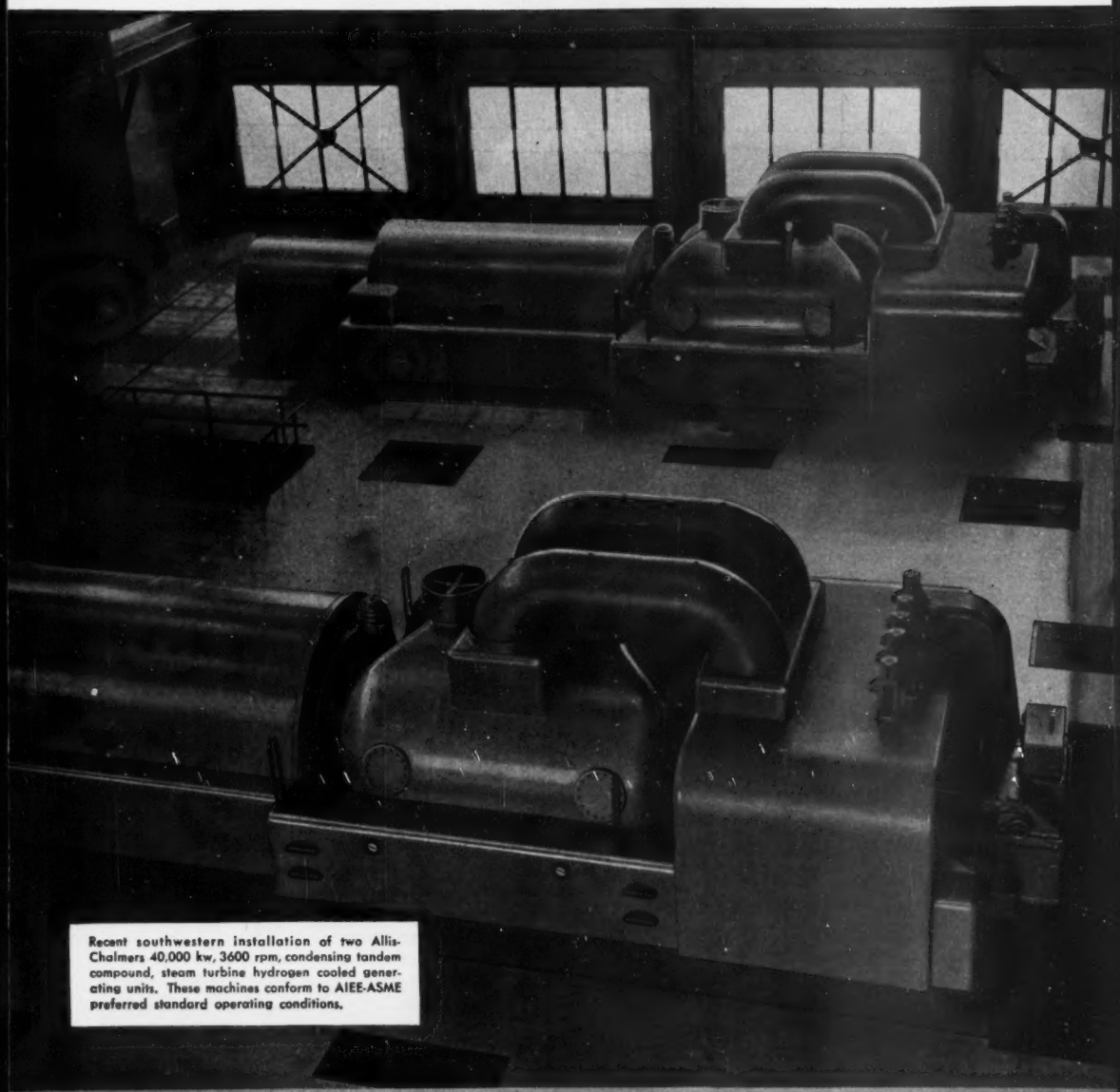
NEW SQUIRREL CAGE MOTOR. One man can perform all routine maintenance procedures, including opening up motor for cleaning. This motor available in drip-proof and splash-proof construction.

SINGLE CIRCUIT UNIT SUBSTATION has all instruments and meters dead-front mounted behind single door. Transformer, breaker, control and relays are all conveniently located in one housing.

Equipment for Power: Water Conditioning equipment, chemicals and service...Steam and Hydraulic Turbines...Generators...Condensers . . . Steam Jet Air Ejectors . . . Power Plant Pumps and Motors . . . Transformers . . . Circuit Breakers . . . Switchboards and Control . . . Switchgear . . . Unit Substations . . . Utilization equipment.

ALLIS-

Power Headed?



Recent southwestern installation of two Allis-Chalmers 40,000 kw, 3600 rpm, condensing tandem compound, steam turbine hydrogen cooled generating units. These machines conform to AIEE-ASME preferred standard operating conditions.

CHALMERS

A-C ALLIS-CHALMERS

STRONG LINKS

for an important chain . . .

Southern States' 160 page Connector and Bus Support Catalog lists and illustrates all fittings. It is indexed and cross indexed for quick reference. Write for your copy of this catalog on your letterhead.

You can't afford to gamble with system outages due to the failure of any link in your power equipment chain.

For example, all substation components are important links . . . including connectors and bus supports . . . and must be selected with the assurance that they will function properly under all conditions. Southern States' comprehensive line of power connectors and fittings meets every substation requirement. These fittings have been designed for long life and dependable service.

All SS fittings are designed for maximum strength and high conductivity. Contact surfaces are rough ground to provide multi-point high pressure engagement with conductors. Connectors are accurately ground to conform to the curvature of conductors assuring proper electrical and mechanical engagement.

The wide range of types and sizes in connectors and bus supports for all types of conductors simplifies your choice of the right fitting for normal applications. Special designs can be supplied to meet specific requirements.

Southern States HAMPTON **Equipment Corp.** GEORGIA

ZOOMING in importance

the advantages of these new all-plastic, light-weight cables

Desirable as they are in any situation, the special advantages of Ansonia Ankoseal Cables reach imperative proportions in the present emergency.

For these cables help the public utility in three important ways. They are lower in cost in most cases. They reduce installation time and thus conserve manpower. They have long-life qualities that reduce frequency of replacement.

All these advantages are yours without sacrifice of, while in many cases there is an improvement of, electrical properties.

Investigate Ansonia Ankoseal for—

SUPERVISORY CONTROL CABLE
STATION CONTROL CABLE
STREET LIGHTING CABLE
METER CABLE

We'll gladly send additional information.

THE ANSONIA ELECTRICAL COMPANY

SUBSIDIARY OF NOMA ELECTRIC CORPORATION

ANSONIA, CONNECTICUT

saving aluminum here

saving of critical materials is not solely the prerogative of the huge giants of Industry. Here is a prime example of how a small Industrial Manufacturer is helping the Central Station Industry make substantial savings of aluminum.

Many Utilities are installing transmission lines using 795,000-CM, 26x7 ACSR. When this conductor is installed, using ordinary accessories, there are required at each support:

1—Aluminum suspension clamp . . .	10.63 lbs.
1—Set of tapered armor rods	13.7 lbs.
2—Ovoid clamps @ 0.68 lbs.	1.36 lbs.
	25.69 lbs.

But the equivalent Preformed Armor Rod installation requires only:

1—Smaller suspension clamp	7.91 lbs.
1—Set of 0.310" Preformed Aluminum Rods 100" long	10.10 lbs.
No Ovoid clamps	.....
	18.01 lbs.
saving—	7.68 lbs.

This results in a saving of 30% of critical aluminum. Similar savings develop for all sizes of conductor. And to further reduce the total consumption of aluminum, some Utilities use Steel Preformed Armor Rods on #4 and #2 ACSR.

saving of even more aluminum is made possible by using Preformed Armor Rods to:

1. Repair and rebuild transmission lines.
2. Rehabilitate old conductors.
3. Increase the current-carrying capacity of existing lines.
4. Lengthen the life expectancy of present and future lines.

armor rods today assure more operating conductor tomorrow

means more miles of conductor . . .

Preformed Armor Rods will . . .

- **INCREASE** the current capacity of splices, conductors in clamps, dead-ends and so on, by more than 30%.
- **LENGTHEN** the life of conductors where vibration, arcing and burning take their toll.

Easily installed in three minutes . . . even by inexperienced linemen . . . Preformed Armor Rods protect conductors better and at lower cost than ordinary armor.

They are better because only PLP rods grip uniformly over the entire conductor length.

They are less expensive because your linemen make perfect installations every time, far quicker than with ordinary armor. Less expensive because only PLP rods eliminate concentrated stresses common in other forms of conductor protection.

Complete technical details and installation records are available. Just write to: *PREFORMED LINE PRODUCTS COMPANY, 5349 St. Clair Avenue, Cleveland 3, Ohio.*

PLP ARMOR RODS ARE AVAILABLE IN ALUMINUM, COPPER, BRONZE, COPPERWELD, STAINLESS STEEL AND GALVANIZED STEEL—A TYPE FOR EVERY CONDUCTOR.

Take half to all of the rods needed and lay them across and around the conductor.

Wrap around conductor several times . . . like wringing water from a cloth. Apply remainder of rods.

Continue wiping action along conductor.

The finished job.

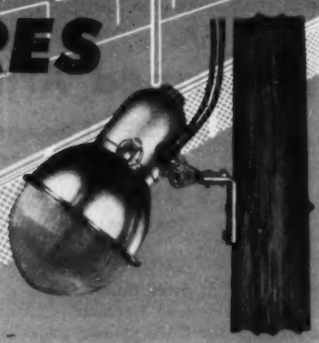
PREFORMED

PLP

LINE PRODUCTS CO.

CLEVELAND 3, OHIO

DEFENSE PLANT LIGHTING with JOSLYN LUMINAIRES

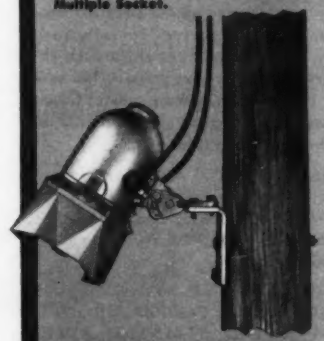


Enclosed Wedge Bond Luminaire for I.E.S. Type I Light Distribution for 2500-10,000 L. Lamps.
Catalog No. J07079-F with Series Receptacle and Socket.
Catalog No. J07279-F with Mogul Multiple Socket.

Fence and yard lighting will be simplified by using Joslyn luminaires mounted on 2-way adjustable brackets (or on standard pipe brackets, if desired for vertical mounting).

You can obtain all the advantages of scientifically designed protective lighting units at moderate expense. Some of the advantages of Joslyn luminaires include:

1. **Most effective light control—I.E.S. Type I light distribution beamed at an angle effectively illuminates a maximum linear distance along a protective fence and throws sufficient light on inside and outside areas to illuminate any intruders.**
2. **Enclosed moisture-proof, dust-tight luminaires, or 18-8 Stainless Steel Open Reflectors—either type requires a minimum of maintenance.**
3. **Durable construction throughout; designed and manufactured to do an efficient job of lighting vital outdoor areas.**
4. **Adjustable pole mounting bracket shown in photographs is made of hot galvanized, malleable iron; it can be tilted 30 degrees up or down, and 30 degrees to right or left of central position.**



18-8 Stainless Steel Permalux open Luminaire for I.E.S. Type I Light Distribution for 2500 L. Lamps.
Catalog No. J07071-L with Series Receptacle and Socket.
Catalog No. J07371-L with Medium Multiple Socket.

Branch offices in principal cities
•
THE JOSLYN CO.
THE SOUTH EAST-JOSLYN CO.
SOUTHERN JOSLYN CO.
JOSLYN SOUTHWEST CO.
JOSLYN-PACIFIC CO.

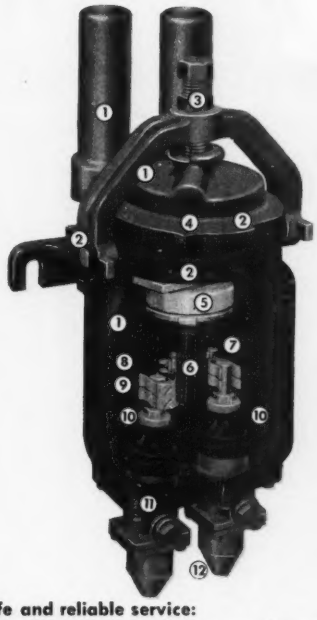
JOSLYN MFG. AND SUPPLY CO.
Complete Pole Line Equipment
30 NORTH WACKER DRIVE, CHICAGO 6, ILL.

USE G&W OIL FUSE CUTOUTS

For Disconnecting and Protecting Primary Circuits in any Location

Explosion-proof

Load Break Oil Switching or Short Circuit Fusing



Here are 12 reasons for safe and reliable service:

1. Rugged, pressure-tight, ALL STEEL, tank, cover, cover clamp and expansion chamber. Cover clamp hinges on stainless steel pins.
2. Cover and cover clamp interlocked to prevent withdrawal or insertion of fuse carrier except in the OFF position.
3. Large screw and locknut insures perfectly tight gasketed joint between cover and tank in either ON or OFF position.
4. Cover easily switched OFF and ON with removable rod. Readily adapted for gang operation. Sleet and ice will not prevent operation.
5. Higher voltage ratings have porcelain insert between fuse chamber and cover.
6. Short circuits quietly and definitely cleared in ½ cycle.
7. Simple inexpensive fuse link is easily replaced.
8. Fuse link and all live contacts are well below the oil level. Oil level is not critical.
9. Beryllium copper spring contacts carry current without excess heating and are not subject to fatigue.
10. Unit detachable compound-filled potheads seal cables and prevent migration of oil from tank. Porcelain bushings protect cable ends against surges.
11. Permanently oil-tight "Resistoyl" gasketed joints.
12. Interchangeable cable entrances at bottom of cutout. Permit logical cable training with minimum wall space.

Write for Bulletin CA50—Ratings, Dimensions, Prices.

Use G & W Cable Accessories for
TERMINATING
FUSING—SWITCHING
SPLICING—CONNECTING

POTHEADS

Trouble-Free Cable Terminations

Capnut Style Disconnecting Straight Through

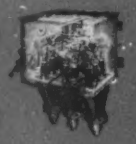
Write for Bulletin AB51
Type "ST-SODERTITE"

Write for Bulletin AA50

LOAD BREAK OIL SWITCHES

600, 7,500, 15,000 and 23,000 Volts.

400 Ampere Load Break



Rocker Arm Links in Many Switching Arrangements.

CABLE BOXES

Air or Oil Filled

Fuses, Links or Direct Connection

Many Sizes, Styles, Ratings

UNIT SPLICING KITS

Packaged Materials for Properly Designed Joints for all Types of Cables

Write for Bulletin J50

G&W ELECTRIC SPECIALTY COMPANY
7780 DANTE AVENUE • CHICAGO 19, ILLINOIS, U.S.A.
Representatives in principal cities. In Canada, Powerlite Devices, Ltd., Toronto

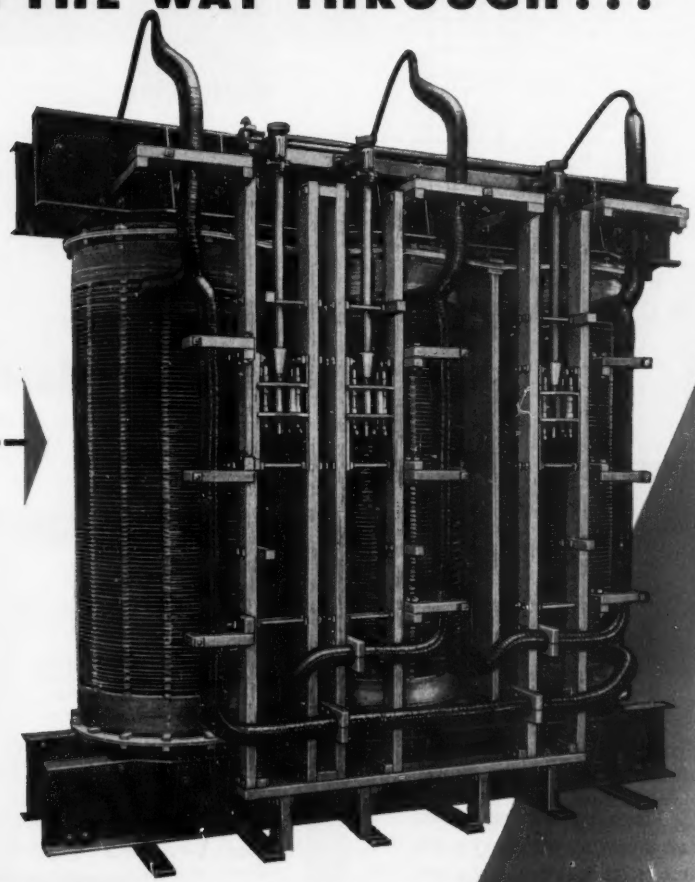
Wagner Power Transformers have a reputation for quality—inside and out—established through sixty years of service to the power industry and proved by service records from the field, dating back to the early 1900's. They are liberally designed and are built with painstaking care to enable them to give years of uninterrupted service. Use of highest quality materials and rigid inspection and tests have made Wagner Power Transformers "the choice of leaders in industry."

Wagner maintains thirty-one branch offices, located in principal cities, for quick, convenient engineering service and consultation. Consult the nearest branch for competent advice on your next transformer installation.

Wagner Electric Corporation
1891 1951

POWER TRANSFORMERS

ALL THE WAY THROUGH . . .



Wagner Power Transformer Elements are particularly outstanding because of their inherent strength and stability and because of their compact design and careful construction. They have sufficient capacity to not only carry their normal load but to be able to handle an overload when the emergency arises.

That's why Wagner Transformers have established records for continuous service and long life in all types of industrial plants and transmission lines. The complete story of Wagner Power Transformer construction is told in Bulletin TU-181. Write for your copy.

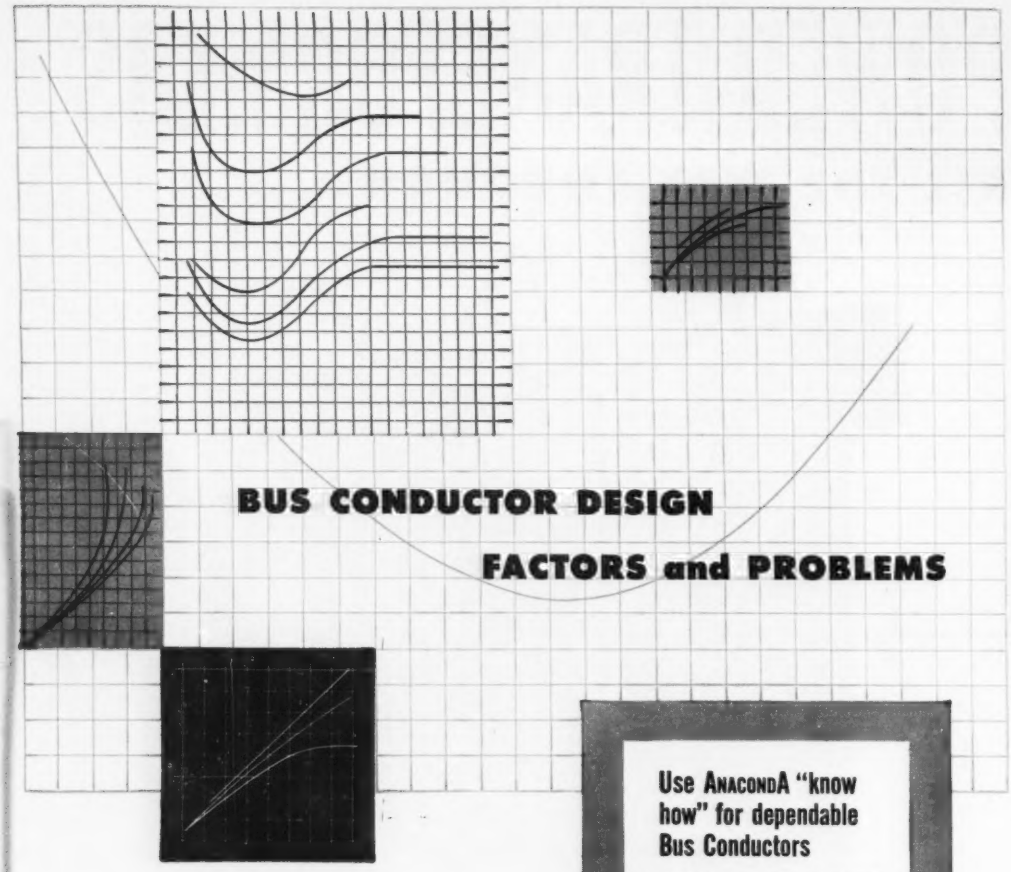
WAGNER ELECTRIC CORPORATION

6456 PLYMOUTH AVE. • ST. LOUIS 14, MO., U. S. A.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES

AUTOMOTIVE BRAKE SYSTEMS – AIR AND HYDRAULIC

BRANCHES IN 31 PRINCIPAL CITIES



BUS CONDUCTOR DESIGN FACTORS and PROBLEMS

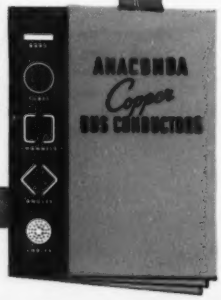
Basic data for Bus Conductor selection

Performance curves, derived from data obtained by test of typical bus conductor arrangements presented in this book, can be interpolated to facilitate selection of a conductor arrangement best suited for an individual application. In many cases advantage is obtained by use of special conductors. Our Technical Department is always available to engineers for consultation in selecting the most economical and effective types of Bus Conductors for specific requirements. The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 50135

Use ANACONDA "know how" for dependable Bus Conductors

With the inception of electric power in the United States, Anaconda pioneered development of efficient bus conductors. Today ANACONDA *products, techniques and technicians are cooperating effectively throughout the entire field of power generation, distribution and application to provide bus equipment that will afford an optimum combination of capacity, security and economy for any specified job.*

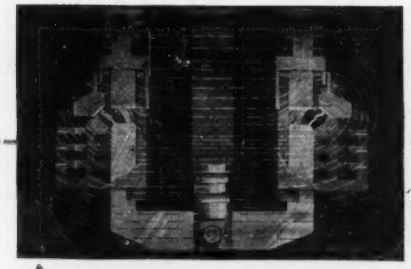
Write for new edition of Publication C-21.



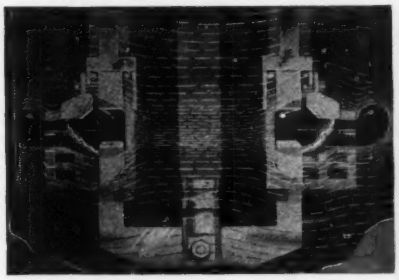
Carry the load with ANACONDA Bus Conductors

YOU CAN BE **SURE**.. IF IT'S

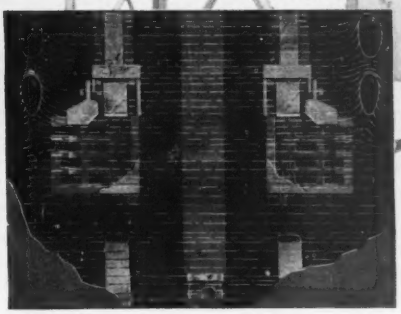
Westinghouse



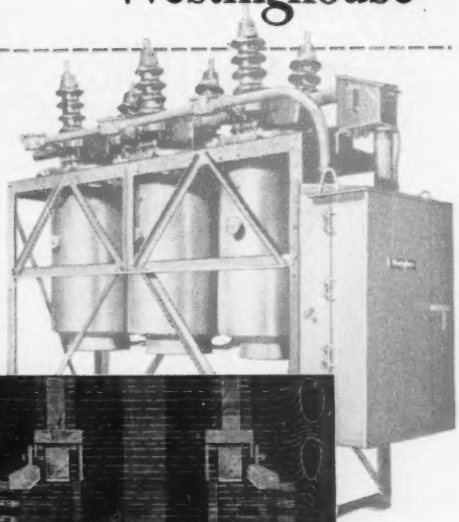
▲ Contacts partially open. The arc is lengthened by magnetic action and vaporizes oil. Upper arc terminal has transferred to arc horn.



▲ Deionizing action takes place. Un-ionized gas is directed through arc to extinguish it.



Arc completely extinguished. Fresh oil replaces gas in grids. Contacts fully opened. ▶



Exclusive "De-ion®" Grid Arc Control

CHECKS COSTLY OIL DETERIORATION!

Low arc voltage . . . low arc energy . . . these important advantages of "De-ion" Grid arc control assure greatly reduced oil carbonization and deterioration when you use Westinghouse Outdoor, Frame-Mounted Circuit Breakers. You save the cost of frequent oil replacement . . . you're sure of *improved* service continuity.

Rapid control of fault current is accomplished by vaporizing oil trapped in pockets. "De-ion" Grids quench the arc by magnetically forcing it into the grid, where oil provides a fresh flow of un-ionized gas. The dielectric strength is thus raised to a point where the arc cannot restrike. The effect of the "De-ion" Grids is graphically shown by the three progressive illustrations shown here.

Get the facts about all the cost-saving features of Westinghouse Breakers. Call your nearby Westinghouse representative, or write for booklet B-3686-A. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-60736

DESIGN TESTED AND VERIFIED IN THE Westinghouse HIGH POWER LABORATORY

Westinghouse

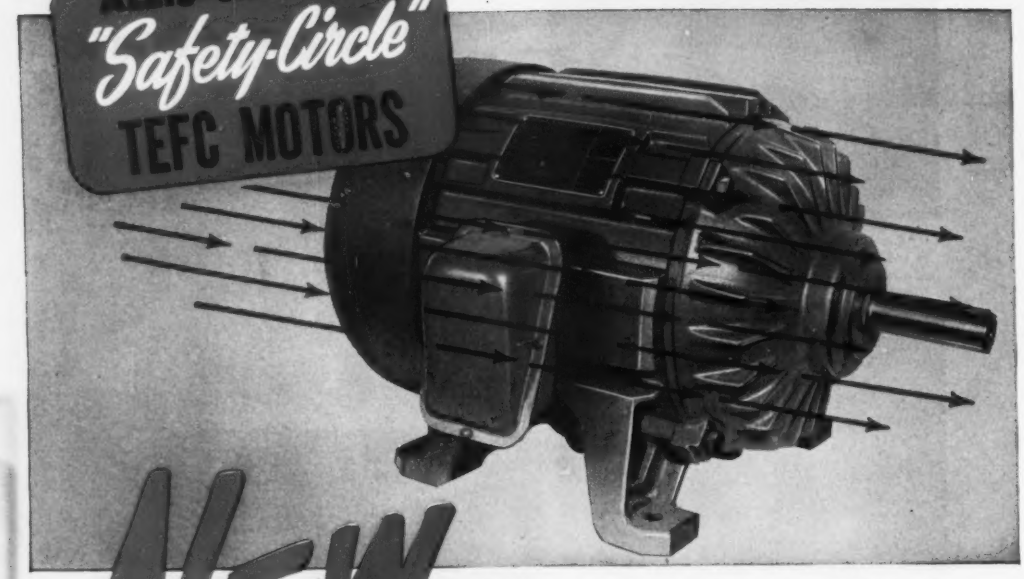
POWER CIRCUIT BREAKERS

WESTINGHOUSE

ALLIS-CHALMERS

"Safety-Circle"

TEFC MOTORS



NEW Easy to Clean Resists Corrosion

CORROSIVE ATMOSPHERES CAN'T HURT this Allis-Chalmers totally enclosed, fan-cooled motor because major parts are enclosed in a rigid corrosion resistant cast iron frame! No extra treatment is needed and cast iron's corrosion resistance won't chip off.

Lower Maintenance, Too

No corners, pockets or hidden air passages to collect dirt. Cleaning is the simplest of maintenance operations. Just blow off the dirt with an air hose. Fan and housing design keep cooling airflow tight against the yoke so dirt does not accumulate and cleaning is seldom required.

Factory Lubricated Bearings

Bearings are lubricated at the factory and operate without attention or cost for years. Extra rigidity of the cast iron frame holds bearings in true alignment under all operating conditions. This gives long bearing life and low operating costs.

Get All The Facts

The new *Safety Circle* totally-enclosed fan-cooled motor is built in all NEMA standard frame sizes from 224 to 505. Call your nearest Allis-Chalmers Authorized Dealer or Sales Office for complete information or write Allis-Chalmers, Milwaukee 1, Wisconsin. Ask for Bulletin 51B6144. A-3228

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

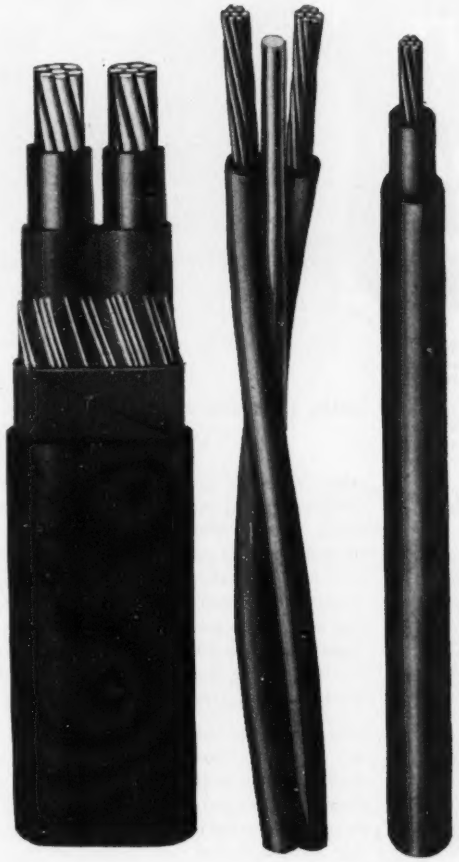
TEXROPE — Belts in all sizes and sections, standard and *Vari-Pitch* sheaves, speed changers.

PUMPS — Integral motor and coupled types from ¾ in. to 72 in. discharge and up.

Safety Circle, Texrope and *Vari-Pitch* are Allis-Chalmers trademarks.

ALLIS-CHALMERS

SERVICE ENTRANCE CABLES



TYPE SE TYPE SS TYPE USE

Roebling makes a wide line of service entrance and service drop cables

SERVICE CABLES are an important part of Roebling's complete line of electrical wires and cables. Whatever your requirements for getting electrical energy from the utility's secondary to the meter, the right Roebling underground or overhead cable will give you the fullest measures of dependability...and economy.

All types and styles of Roebling Service Entrance Cable are made in the constructions best adapted for their own particular service range. From copper wires to protective jackets these cables are made entirely in Roebling plants where modern machines and methods assure highest, uniform quality.

A large part of Roebling's complete wire and cable line is required in today's rearmament program. You can count on the Roebling organization and distributors, however, to give you the best possible delivery service. John A. Roebling's Sons Company, Trenton 2, New Jersey.

ROEBLING

Atlanta, 934 Avon Ave ★ **Boston,** 51 Sleeper St ★ **Chicago,** 5525 W. Roosevelt Rd ★ **Cincinnati,** 3253 Fredonia Ave ★ **Cleveland,** 701 St. Clair Ave, N.E. ★ **Denver,** 4801 Jackson St ★ **Houston,** 6216 Navigation Blvd ★ **Los Angeles,** 216 S. Alameda St ★ **New York,** 19 Rector St ★ **Odessa, Texas,** 1920 E. 2nd St ★ **Philadelphia,** 230 Vine St ★ **San Francisco,** 1740 17th St ★ **Seattle,** 900 1st Ave, S. ★ **Tulsa,** 321 N. Cheyenne St

"It has won my confidence over the years

That's why I Specify

ORANGEBURG"

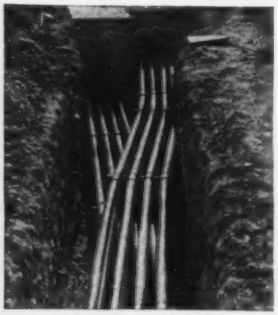
— says the Utility Engineer

Here are some of the reasons why this Utility Engineer, and many others like him, entrust their vital cables to Orangeburg for permanent protection.

• **Will not corrode. Lasts indefinitely.** • **Impermeable wall and tight joints prevent corrosive ground waters from entering.** • **Lays faster and at lower cost than any other type of conduit.** • **Low coefficient of friction keeps pulling tensions on cable to minimum.** • **Protects cable sheath from abrasion when pulled in—also from wear during cable movement due to alternate expansion and contraction with changing loads.** • **Resists acids, alkalis, grease, oil.** • **Light, easy to handle and tool on the job.** • **Tough, resilient—will not crack or break when properly handled.**

ORANGEBURG NOCRETE

Installed *without* concrete encasement. Its extra heavy wall makes NOCRETE practical for many single or double duct runs.



ORANGEBURG STANDARD

Installed with concrete encasement. The *preferred* conduit for banks of three or more ducts.

OUR NATION MUST HAVE UNINTERRUPTED POWER

One of today's great national assets is the continuous flow of power to industry, business and home. Every utility engineer knows that the unfailing supply of power depends on well protected cables. Cables always get that protection from Orangeburg Conduit. For 58 years, Orangeburg has successfully served the Electrical Industry because of its proved ability to provide a time-defying raceway for the permanent protection of electrical services underground.

And now as the Nation looks to the public utilities and municipalities to maintain and even increase their high standards of service, more and more of them are turning to Orangeburg Conduit. They are doing this because experience has made them sure that cables installed underground in Orangeburg *stay safe* and *keep the power flowing.*

ORANGEBURG MANUFACTURING CO., INC., ORANGEBURG, N. Y.

ORANGEBURG FIBRE CONDUIT

STANDARD Installed with Concrete

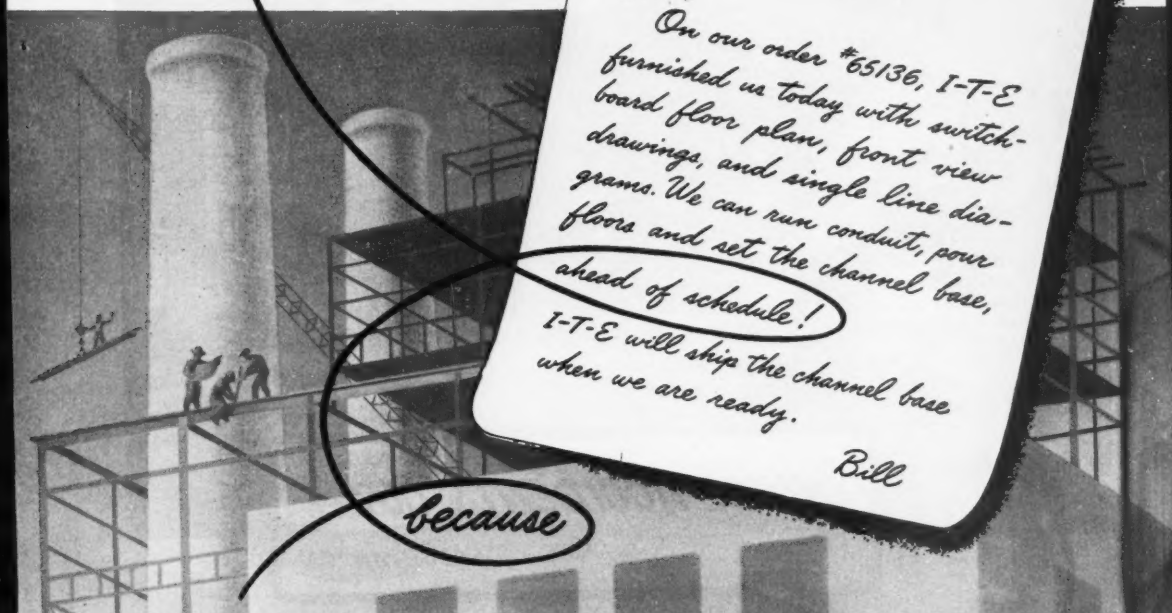
NOCRETE Installed without Concrete

GENERAL ELECTRIC SUPPLY CORPORATION

DISTRIBUTORS, ORANGEBURG FIBRE CONDUIT

GraybaR ELECTRIC COMPANY

Your construction



Memorandum

From. W L. MARTIN, ENGINEERING DEPARTMENT

To J. Forbes, Construction Department

Subject. I-T-E Switchgear

Jim,

On our order #65136, I-T-E furnished us today with switchboard floor plan, front view drawings, and single line diagrams. We can run conduit, pour floors and set the channel base, ahead of schedule!

I-T-E will ship the channel base when we are ready.

Bill

because

When you build a new building or expand existing facilities, you must have perfect timing in coordinating construction schedules. For example, early in your construction planning you need basic drawings. Naturally, many of these drawings come from your suppliers. If they are tardy, you may have trouble meeting construction schedules.

At I-T-E we take a real interest in the solution of this customer problem. When you buy an I-T-E switchboard or unit substation, your order is placed well in advance of the shipping date. But we know that before you can install the equipment, floors must be poured, conduits provided for, and the channel base grouted in place. To do these things, you need certain switchgear drawings, and if you are like most of our customers, you want them quickly. Consequently, when your order is placed with I-T-E, the drawings you need quickly are prepared promptly. Result: you can complete your floor, spot your conduit and set in your channel base *on or ahead of construction schedules.*

—another reason why I-T-E is your best switchgear buy!

For further information on I-T-E Multumite Switchgear contact your local I-T-E representative or write to the I-T-E General Office.

I-T-E

For *more dependable* Switchgear

—specify I-T-E!

R&IE

I-T-E Circuit Breaker Company • 19th & Hamilton Streets • Philadelphia 30, Pa.

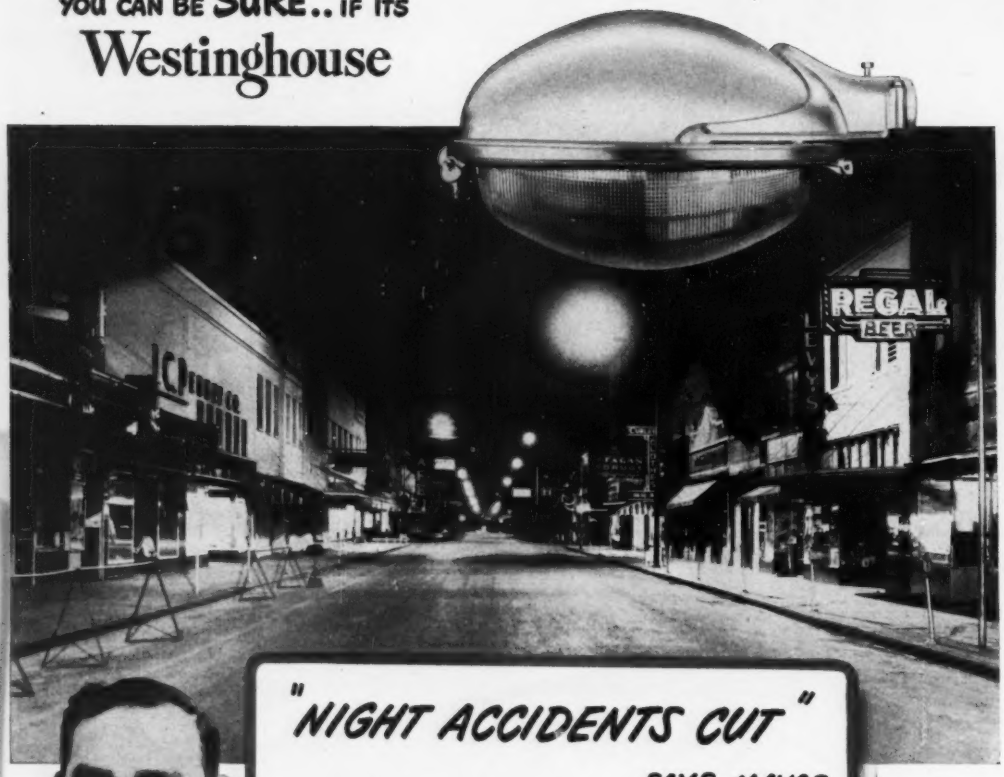
Power Switching Equipment: Railway and Industrial Engineering Co., Greensburg, Pa.

Canadian Mfg. & Sales: Eastern Power Devices, Ltd., Toronto • Export Sales: Philips Export Corp., New York

SWITCHGEAR • UNIT SUBSTATIONS • ISOLATED PHASE BUS STRUCTURES • CIRCUIT BREAKERS • MECHANICAL RECTIFIERS • RESISTORS • SPECIAL PRODUCTS

YOU CAN BE **SURE**.. IF IT'S

Westinghouse



"NIGHT ACCIDENTS CUT"

... SAYS MAYOR

Mayor James A. Stire, Hammond, Louisiana reports:

"Besides being very attractive, the new Westinghouse mercury-vapor lights have been an immeasurable aid to traffic safety. The increased visibility they afford has greatly cut down the number of night traffic accidents. They also add to the protection of business places from burglars.

"We feel that the lights are one of the greatest assets of our city."

James A. Stire

This is only one of hundreds of case histories proving the economy of Westinghouse street lighting, a story Westinghouse is telling your customers—the readers of municipal papers.

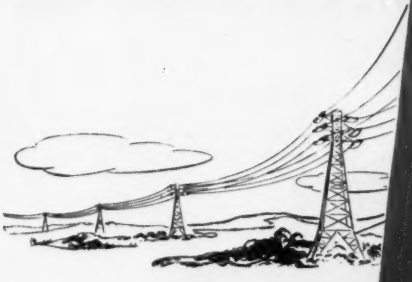
If you want reprints—or other material to promote better seeing in your towns, write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. Ask for B-4332, "Planned Street Lighting for Public Safety".

J-04277

Westinghouse

PLANNED LIGHTING SYSTEMS

ONE COAT TOWER PROTECTION AT ITS BEST!



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Dixon Paint lasts twice as long in Accelerated Weathering Test

DIXON PAINT

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Photos taken after test by UNITED STATES TESTING COMPANY

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As shown above DIXON ONE-COAT GRAY gives long-life protection in UNITED STATES TESTING COMPANY'S impartial and crucial test.

Dixon Paint — practically as good as new — thanks to enduring Natural Flake Silica Graphite!

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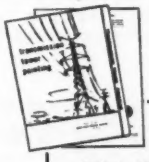
FLAKE SILICA GRAPHITE PAINTS



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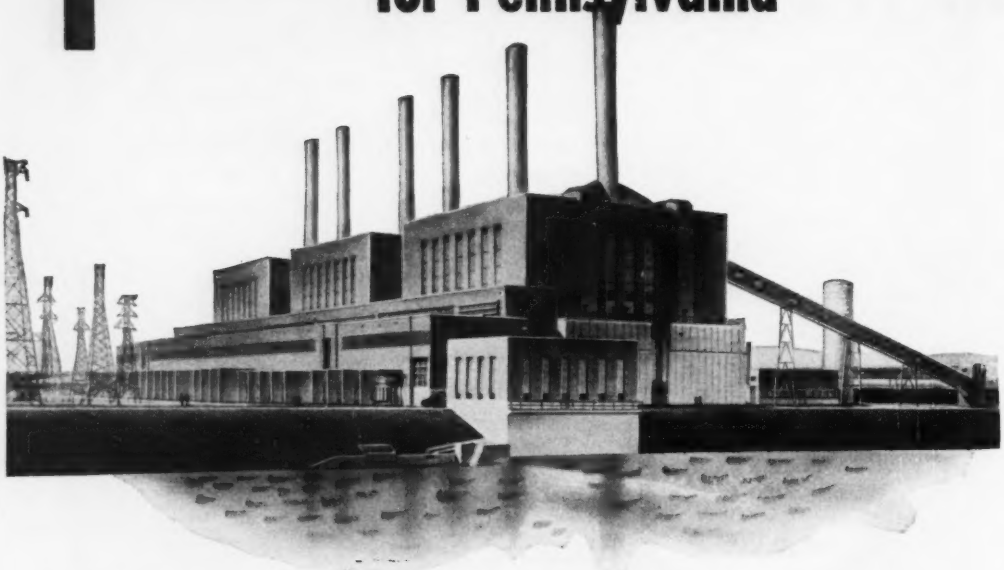
SPECIALISTS IN OUTDOOR PAINTS FOR METALS — FOR ALMOST A CENTURY

power for Pennsylvania



The Sunbury Steam Electric Station now being constructed by EBASCO for Pennsylvania Power & Light Company, with an ultimate generating capacity of 550,000 KW, will be the world's largest pulverized anthracite-burning power plant.

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Ventilated Spark Gaps Plus Transparent Housing Assures Easier Inspection, Efficient Protection

Here's the heavy duty lightning arrester that's been proved on the job in thousands of installations under all conditions . . . available in ratings of 6.0—9.0—12.0 and 15.0 KV. During their 16 years of operation they have established practically 100% performance records from the standpoints of protection, freedom from gap corrosion due to moisture, radio interference and arrester failure.

GLASS BODY FOR EASY INSPECTION OF GAPS

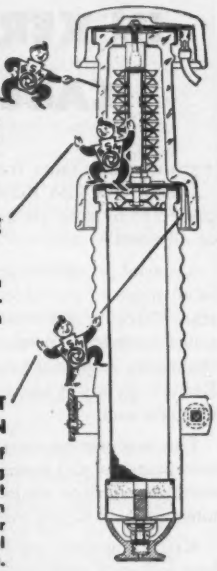
Condition of spark gaps readily seen at all times without removing arresters for testing. Safer protection . . . less labor required for maintenance.

HIGH SPEED MULTIPLE ARCING UNIT

Assures long life, split second action with maximum protection to the transformer and a minimum of stress on its insulation.

VENT OPENINGS TO PREVENT MOISTURE ACCUMULATION

Permits free access of air in and out of spark gap housing. Interior of housing kept dry. Spark gap elements are not subject to deterioration or corrosion from moisture. Write for new folder No. 1709 giving full data on Crystal Valve Ventilated Spark Gap Arresters.



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Editorials

Unity Organization

The Exploratory Group to Consider the Increased Unity of the Engineering Profession, representing 16 national societies, has, through its Planning Committee developed four plans for unifying the engineering profession. Plan A contemplates the expansion of the Engineers Joint Council to include other engineering societies and joint membership in EJC and a professional society (such as AIEE). Plan B is the same as Plan A except it would permit individual membership in EJC. Plan C contemplates the merger of EJC and National Society of Professional Engineers. Plan D proposes adoption of NSPE as the unity organization.

All plans admittedly have their shortcomings, and there are many problems to be overcome before adoption of any one. However great the difficulties involved, the need for a unified professional organization is greater, and an agreeable solution must be arrived at.

The planning committee set forth very adequate principles that should govern the form of organization. These included the following five points:

1. **The unity organization should be formed by the modification and development of a present organization or by the integration of two or more present organizations rather than by the establishment of an entirely new organization.**
2. **The unity organization should initially include the participation of a majority of the national engineering societies represented in the exploratory group.**
3. **Provision should be made for the membership of individuals in the unity organization.**
4. **Control of the governing body of the unity organization should lie in directors appointed or elected by the participating societies.**
5. **The activities of the unity organization should be determined by its governing body under the terms of a broad statement of general purposes in the constitution of the organization.**

Perhaps it would have been advisable to add a sixth point to the effect that—the organization selected should be one that will attract the greatest participation from all segments of the profession.

We believe that of all four plans, Plans A and D will come closer to satisfying all of the principles set forth above. Plan A can be put into effect in much less time than the others. Both A and D maintain our present societies intact. Plan A presents an opportunity to present a united front by a great profession almost immediately. The Engineers Joint Council has already proved itself to be an effective instrument for reflecting viewpoints of the constituent societies.

Plan D has the advantage of requiring no new organization. It suggests that NSPE change its membership requirements for a period of years to permit non-registered engineers to belong.

The objections to the other plans are many. Plan B has nothing to offer over Plan A. It specifies heavier dues for separate EJC membership. Plan C which involves merger of EJC and NSPE would be bogged down by the details necessary to bring it about.

We propose the adoption of both Plans A and D. To fulfill the immediate need for unity we must strengthen the Engineers Joint Council. To provide grass roots cooperation and unity in the future, we need a strong NSPE. We suggest that this be your recommendation to your professional society.

The Plot Thickens

(Reprinted from "Charleston (S. C.) Evening Post")

Perverting the purpose for which it was created, the Santee-Cooper Authority is going ahead with its plans for building and erecting steam power plants to compete with private enterprise.

To finance its venture, it proposes to issue tax-free bonds, a privilege which gives it an unfair advantage over companies which do not enjoy such an exemption.

When a private corporation issues bonds, the interest on them is subject to state and federal income taxes, making them less attractive to investors than securities not subject to such levies. That is not the only advantage which the Santee-Cooper organization enjoys. It is free of state, local, and federal taxes. The money it pays "in lieu of taxes" is only a small fraction of what a private concern of similar size would have to pay.

Thus subsidized by the federal and state governments, the South Carolina Public Service Authority feels free to go beyond the field to which it was intended to be restricted. Balked in efforts to take over private utilities, it now schemes to build its own steam power plants. Unless the courts intervene, or the General Assembly takes action, it will go ahead with its secretly-negotiated program. It is acting as if it were a new and independent branch of the government of the State of South Carolina, subject to no law but its own.

If the Legislature can't be brought to keep the authority to its proper field—that of producing hydro-electric power—it should in ordinary fairness make it subject to the same taxes—income, property and others—under which private enterprise must operate. Otherwise the people of South Carolina will be forced into still higher subsidies for the Santee-Cooper Authority. The private companies and their customers will have a double burden.

There is still another consideration which ought to be borne in mind. The more the Santee-Cooper empire expands, the stronger will its political grip on the state be. There is a danger in this alone that ought to cause the people to rise in protest against the neat little scheme which is being nursed. There ought to be a thorough investigation into the affairs of the Santee-Cooper Authority, and the legislation under which it operates revised in an effort to force it to stick to its proper business

Glamorize the Engineer

Check the publicity releases sent out by any electric company (EW gets thousands each year). Seldom are the engineers or engineering department mentioned. As an example consider the usual release announcing the dedication of a new power plant. If anything in the industry is a triumph of modern engineering such a plant is. An officer of the company points out the contribution to the community. The governor or some other politician makes a speech. There is an explanation of how the company will get or has gotten the millions needed for the plant. But of the engineering problems that had to be solved or of the engineering triumphs accomplished not a word.

At present it is a custom of utilities to keep their engineers in comfortable prisons. There seems to be some stigma attached to admitting that the company has a staff of capable engineers which make its operation possible.

The constant appearance in the press of non-engineering officers tends to demean the engineer in the eyes of the public. Why should a high school student believe that the engineer is important? He is never mentioned. He doesn't do anything exciting. So even if a high school graduate does go to an engineering school and even if he does study electrical engineering, he will be inclined to stay out of the utility field.

One step each electric company should take as quickly as possible is a campaign to make the work of its engineers better known to the public. There are many opportunities for this. Any director of public relations who is worth his salt knows how. All that he needs is the go-ahead sign from upstairs.

If something isn't done to bring the engineer before the public eye, the utilities might have to do something more radical or expensive to get engineers on their payroll in the future.

British Want Coal Not Restrictions

"The Electrician," which calls itself "the technical newspaper of the electrical industry" published in London, keeps a very watchful eye upon the effects of nationalization in Great Britain. It is significant to note abstracts from its recent editorial entitled "Fuel Economy." The quotations which are reprinted below speak for themselves.

"The appeal on Jan. 6 by the Minister of Fuel and Power for economy in the use of coal, gas, and electricity, did nothing to reduce the uncertainty of whether or not a fuel crisis will develop within the next few weeks. The measures he outlined called chiefly for efforts by individual consumers to reduce their demands for fuel and power, whereas the need is for replenishment of the low stocks of coal now held by the power stations. . . .

"As was said in 'The Electrician' of Dec. 1 last, the root of the trouble in the coal industry is to be found in the relationship between the miners and the Board controlling their destiny. Any industry which suffers a fall in manpower from 708,900 in 1949 to 688,100 in 1950 at a time when there is an anxious world-market for its output, is sick at heart and in a condition never experienced under private enterprise. Whether or not the coal industry will produce in the next three months the extra 3 million tons asked for remains to be seen, but in neither case can it have much influence upon the immediate necessity of building up the power station stocks; that can only be done by a further depression of industry. A poor recommendation for nationalization!"

The Electrical Week

IN WASHINGTON—NPA has authorized manufacturers of heavy electrical equipment to use DO's to get steel, copper, and aluminum. This assures them of ample supplies of these metals in May and June. CMP will go into effect on July 1 (p 64) . . . The last two volumes of the report of the President's Water Resources Policy Commission are now available (p 65) . . . The Federal Power Commission has approved the contract between SPA and Southwestern Gas & Electric Co for sale of Narrows Dam (Ark.) energy (p 68) . . . Secretary Chapman still isn't satisfied with FPC's decision to allow the Virginia Electric & Power Co to build a power project at Roanoke Rapids. He has asked for a rehearing (p 68) . . . Makers of appliances and air conditioning equipment will find it harder to secure copper under a new NPA order (p 69) . . . M and Depa orders are listed on page 69 . . . SEC was expected to rule this week on whether it will claim jurisdiction over the proposed sale of Washington Water Power Co by American Power & Light Co to public utility districts (p 70).

ELSEWHERE—The Atlantic States storm which disrupted utility service last November came in for serious discussion at the meeting of Edison Electric Institute's T&D Committee (p 66) . . . Technical advances in equipment were brought out as PEA's Relay Committee met at Pittsburgh (p 67) . . . Prevention of short-circuit damage to large turbogenerator rotors and the abandonment of inhibited oil for the mobilization period were important topics as EEI's Electrical Equipment Committee met at Cleveland (p 68) . . . And output for the week ended Feb. 17 continued its normal seasonal decline (p 71).

• • •

The new DO's for materials for electrical equipment manufacturers (p 64) are not the first granted for power expansion. TVA and Electric Energy, Inc, got them for their steam plants which will supply power to AEC's new Paducah, Ky., plant. TVA also got a DO for its New Johnsonville steam plant.

Electric utilities could save 75,000 to 100,000 tons of copper each year by substituting aluminum—if the aluminum were available—Defense Electric Power Administration estimates.

Under the new Census Bureau definition a farm is a place that produces agricultural products valued at $150 or more exclusive of home gardens. With today's prices this could be a large parsley patch or a plot of scallions.

If you want to make your own weather, you may use General Electric Co patents without charge. GE has announced that until further notice it does not intend to enforce any of its patents relating to weather modification by the artificial production of snow and rain.

The world supply of new rubber in 1951 should be close to 2.8 million tons—greatest in history. Of this total, 1,860,000 tons will be crude rubber and the other 940,000 tons artificial. But trouble in the Far East could upset the rubber cart.

Even Pressly H. McCance, president of Duquesne Light Co, is wearing one of the new identification badges being handed out to metermen and other employees (EW, Jan. 15, p 68). What is more he didn't get badge No. 1 as might be expected. He had to be satisfied with No. 100.

The total number of electrified farms on Jan. 1 was 5,450,000. This was an increase of 450,000 over the total of a year previous and is 93% of the total number of farms reported by the U. S. Census of Agriculture on Dec. 31, 1945.

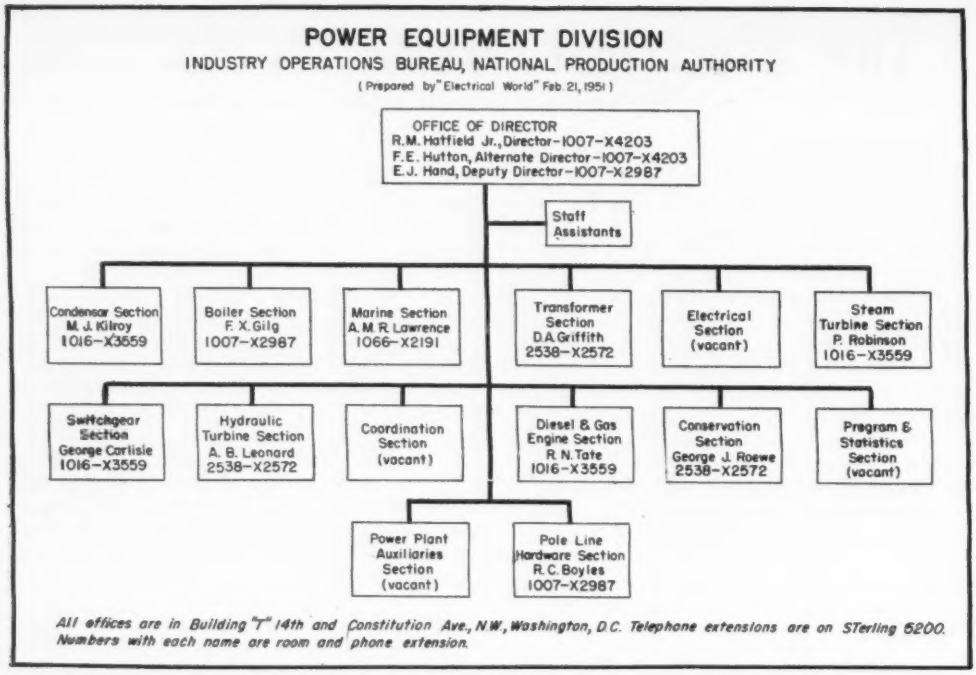
Many business and economic statistics which government bureaus have been publicizing will soon become "secret" for security reasons.

The 80th or "Do-Nothing" Congress was followed by the 81st or "Eighty-Worst" Congress. Robert S. Allen, columnist for many of the papers published by state cooperative associations, calls the present group of federal legislators the "43% Congress." He claims that only 43% of the eligible voters bothered to cast a ballot.

Parents of two infant children buried in the area which will be covered with water when the Buggs Island Dam is built have asked a Federal Court to prevent the Army Engineers from moving the bodies. The parents prefer to have the waters cover the graves.

The Northwest Power Pool reports that the 1950-51 winter maximum instantaneous peak occurred Jan. 29—4,132 Mw for the Western group and 960 Mw for the Eastern group. Coincidental hourly peaks for the same period were 3,988 Mw and 926 Mw.

Maybe it should be the Federal Gas and Power Commission. Of 13 hearings scheduled by the Federal Power Commission during February, two were concerned with power matters and the rest were gas cases.


POWER EQUIPMENT DIVISION
INDUSTRY OPERATIONS BUREAU, NATIONAL PRODUCTION AUTHORITY
(Prepared by "Electrical World" Feb 21, 1951)
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All offices are in Building "T" 14th and Constitution Ave., N.W., Washington, D.C. Telephone extensions are on STerling 5200. Numbers with each name are room and phone extension.

NOT LISTED ON CHART is Ruth Asken who has been appointed chief of the Program & Statistics Section

NPA Allocates Materials to Industry

Manufacturers Expected to Get Ample Supplies of Steel, Copper, and Aluminum for May-June; Utilities Cut on Non-Ferrous Metals

Manufacturers of heavy electrical equipment are expected to get practically 100% of their materials requirements for May and June. They will get them under a new system established by the National Production Authority's Power Equipment Division (PED). The manufacturers are now authorized to use Defense Orders (DO's) for steel, copper, and aluminum for delivery in those months. But all materials secured with DO's must go into equipment which has been approved by PED.

It has also been learned that NPA will issue a directive to Defense Electric Power Administration allocating for utility use about 42 million lb of aluminum for the second quarter. The utilities had specified requirements of 60 million lb for the same period. It is also expected that copper allocations will be approximately 60% of the total requested by the companies in their reports to Depa.

The aid to manufacturers came at a time when the materials situation was getting critical. Some 12 to 15% of the total production of generating units for the year has been lost, according to Robert M. Hatfield, Jr, PED director. He predicts that deliveries of generating equipment will be two to five months behind schedule by July 1.

Materials deliveries to manufacturers thus far have been only 40 to 60% of requirements so far this year. The electrical firms have been competing with all other civilian, non-DO users for the declining stocks of essential metals. Before the DO's take effect in May, the capacity lost will be from 700,000 kw to 900,000 kw of this year's 6-7-million-kw potential. With backlogs of orders stretching for years ahead the loss cannot be picked up for some time.

NPA has assigned unannounced quantities of steel, copper, and aluminum to its PED for DO-order distribution to manufacturers. The totals are understood to be approximately the entire estimated requirements of the industry for the May-June period. This is in line with information EW has that the manufacturers would definitely get 100% of their steel requirements. The steel would be of little value unless manufacturers could get ample supplies of the other scarce materials.

To qualify for DO status equipment manufacturers must apply to PED on two forms (NPAF-30 and NPAF-31) which were distributed recently. Form 30 requests data on consumption of iron, steel, copper, aluminum, and magnesium for the fourth quarter of

1950 and estimated requirements for the first two quarters of 1951. The DO quotas for May and June were computed from the N-30 forms.

Form 31 Covers 11 Types

Form 31 is the order board form. It calls for seven basic facts on each order plus specialized information for each of 11 types of equipment. These are as follows:

1. Steam-propelled turbine generator sets.
2. Mechanical-drive turbines.
3. Hydraulic turbine generator sets, hydraulic turbines, or generators for such sets.
4. Gas engine generator sets and engines or generators for such sets operating at less than 750 rpm.
5. Internal combustion engines for mechanical drive or engines with integral compression cylinders.
6. Power boilers including various auxiliaries.
7. Coal pulverizers.
8. Steam condensers.
9. Circuit breaker orders over $5,000 and all DO's consisting of air circuit breakers, except types AB, ET, or similar, oil breakers of 2,200 v and above, and metal enclosed switchgear and power switchboards.
10. Switchgear over $5,000 and all DO's regardless of size.
11. Liquid-filled and dry-type transformers with a capacity of 501 kva and larger, designed for single phase and multiple phase operation above 15 kv.

In addition to these types of equipment PED plans to extend its coverage to distribution transformers, pole line hardware, and some other power equipment.

First PED Order in Works

PED's first formal order to electrical equipment manufacturers is now being prepared. It will prohibit shipment of heavy power equipment without NPA approval. Blanket approval for shipping all unfilled orders reported on NPAF-31 is expected.

Robert M. Hatfield, who became director of PED several months ago, still needs men for his organization. But he has succeeded in getting a large staff of industry experts to join him in Washington. Hatfield is on leave from Combustion Engineering-Superheater, Inc, where he served as general manager of the western division with

ROBERT M. HATFIELD

headquarters at Los Angeles. Alternate director is F. E. Hutton, Babcock & Wilcox Co. E. J. Hand, formerly with the Commerce Department's Office of Small Business, is serving as deputy director.

Section chiefs are:

Boiler—F. X. Gilg, Babcock & Wilcox Co.
Condenser—M. J. Kilroy, Westinghouse Electric Corp.
Conservation—George Roewe, Rural Electrification Administration.
Diesel & Gas Engine—R. N. Tate, Worthington Pump & Machine Corp.
Hydraulic Turbine—A. B. Leonard, private business, Los Angeles.
Marine—A. M. R. Lawrence, consulting engineer.
Pole Line Hardware—R. C. Boyles, Line Material Co.
Program and Statistics—Ruth Asken, Economic Cooperation Administration.
Steam Turbine—P. Robinson, General Electric Co.
Switchgear—George Carlisle, Railway & Industrial Engineering Co.
Transformer—D. A. Griffith, Allis-Chalmers Manufacturing Co.

Chiefs are still needed for the Electrical, Coordination, and Power Plant Auxiliaries Sections.

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81,250-Kw Unit Ordered

Boston Edison Co has ordered a second boiler and 81,250-kw generator for installation at its Edgar steam plant in North Weymouth, Mass. It will be a reheat unit, 1,000 F and 1,400 psi.

Last 2 Volumes of WRPC Report Now Available

"Ten Rivers in America's Future" and "Water Resources Law," Volumes II and III respectively of the report of the President's Water Resources Policy Commission are now available. With their publication the entire report has been printed.

Vol II is an 801-page study of the development—past, present, and future—of ten major river basins in the United States. The book contains few new recommendations but discusses development of the rivers with encyclopedic thoroughness, augmented by charts and maps. The volume was prepared by the commission's staff, working with representatives of federal agencies.

The ten rivers are the Columbia; Central Valley, Calif.; Missouri; Colorado; Rio Grande; Connecticut; Alabama-Coosa; Potomac; Ohio; and Tennessee.

Vol III is a complete summary of water resources law and will make a valuable source of reference. A staff of 11 lawyers, nine of whom were from federal agencies having responsibilities in the water resources field, prepared the report. They worked under the direction of Bernard A. Foster, Jr, who served as general counsel.

Any or all of the three volumes can be purchased from the Superintendent of Documents, Washington 25, D. C.

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Montana Law Clears Way for Cabinet Gorge Dam

Gov John W. Bonner of Montana has signed into law the enabling legislation for the Washington Water Power Co to construct the $35-million Cabinet Gorge Dam in Idaho.

The bill permits backing up into Montana the waters of the Clark Fork River from the dam site, a mile from the western Montana border.

When built, the dam will almost double the power-producing capacity of the company. The Federal Power Commission earlier this month granted permission to Washington Water Power to build the dam.

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Franchise Is Granted

Iowa Public Service Co has been granted a 15-year franchise by a vote of the citizens of Clarion, Iowa.

EEI 'T & D' Committee Discusses Restoration of Service After Storms

Panel discussions and symposia on water in underground systems, on joint use agreements, on service restoration after major storms, and on safe design of distribution systems made up the bulk of the program of the Edison Electric Institute Transmission and Distribution Committee in Atlanta, Feb. 15 and 16.

Inhibited Oil Out

Inhibited oil will not be supplied with distribution transformers by Allis-Chalmers, General Electric, and Westinghouse after the present stocks of inhibitor are exhausted. All three announced that military requirements will absorb practically the whole supply available to transformer manufacturers. Manufacturers may not return to the inhibited oil supply until the utilities decide whether they want it for circuit breakers and power transformers as well as for distribution transformers.

The "T & D" committee's review of utility system experience in the Atlantic States storm of Nov. 25 was keynoted by one member's observation that, "We cannot live with present-type system in the face of storms as severe and as frequent as those of 1938, 1944, 1948, and 1950."

Restoration Experiences Reviewed

A review of restoration experience on utility systems with more than 100,000 outages revealed these significant points:

1. Prompt survey of damage is the key to orderly restoration.
2. This was a "tree down" rather than a "broken limb" storm.
3. Radio communication saved the day as telephone systems collapsed.
4. Customers were happiest when told how long service would be out.
5. Distribution deadends on wood insulator pins are doomed.
6. Faced with 3 days of restoration work, crews are best worked 12-16 daylight hours, fed well and sent to rest at night.
7. A single radio channel is easily jammed in such an emergency unless traffic is controlled.
8. A management "cushion" against outside pressure for "special" treatment of influential customers is vital.
9. Public relations departments shone brilliantly in some areas, failed to explain local situations in others.

Handling of Calls Compared

Comparison of the systems used by four major utilities in handling trouble calls during major storms revealed these points of significance:

1. A factor of 1 to 1½ customers interrupted per transformer kva out service is used for estimating purposes.
2. Use of one man and truck for light trouble shooting is common.
3. Systems for handling storm trouble can be expanded and used for civil defense planning.
4. When telephone trunk lines are jammed, calling customers are happier when they hear busy signals than when ringing tone is unanswered.
5. Regular changes in company unlisted phone numbers are desirable if they are to serve their purpose.

Water Practices Differ

Practice as to exclusion or toleration of water in ducts and manholes differs widely. This was revealed at an 8-man panel session on underground. Dryness is facilitated in some instances by vibrating the concrete for density and using cork-gaskets for fiber duct joints. Gas testing of splices at 7 to 15 psi is common. Soapsuds are deemed futile below the oil level.

Some form of kiln drying is preferred over steam conditioning by the timber products subcommittee, according to F. A. Ashbaugh, West Penn Power Co. Jacoby of Detroit Edison believed that 5% pentachlorophenol is equal in toxicity to creosote and there is no further necessity of mixing them. The Insulator Committee said the standards are converging to a mere 5 units, and Chairman R. M. Havourd, Newark, said the wire grooves are being enlarged to provide for armor rods. Along with the previous chairmen E. K. Karcher, New York Power & Light Co, reported exceptionally high balloting returns on the hardware specifications. End is in sight for the fuse standardization efforts now that compromises have been achieved for the very slow or fast fuses, said W. L. Vest, Jr, Western Massachusetts Electric Co.

W. C. Phillips, New England Power Service Co, revealed that the National Committee for Utility Radio last week warned utilities that individual power companies will require the fullest use of their own radio facilities in the event of enemy action. No plans should be made, NCUR warned, that contemplate the use of any radio system in the Power Radio Service for general civil defense purposes.

Network transformer failures in 1947-49 were slightly higher than for 1944-46 as reported by J. A. Pulsford, who added that preliminary data also showed a 10% higher failure rate for non-flammable liquid-filled units than oil-filled. The few dry type (Class B) reflect a sixfold failure rate. The latter were involved in 6 explosions while the much larger number of oil-filled provided 10.

Water cooling of ducts carrying heavily loaded cables and vaults with the associated transformers has effected a saving of some $66,000 each year on the Union Electric system (St. Louis). Andrew Bodicky estimated an annual cost of $28,000 for 35,000 kva of transformers against $92,000 for the additional capacity charges to relieve the present equipment.

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Utility, Chemical Firms to Study Atomic Power

Detroit Edison Co will cooperate with the Dow Chemical Co in studies leading to the production of plutonium and electricity from atomic energy. The Monsanto Chemical Co will make a similar study. The Atomic Energy Commission has given its authorization for the project, marking the first time such authorization has been given to private industry.

J. W. Parker, president of Detroit Edison, and Dr M. E. Putnam, Dow general manager, proposed the plan which was accepted by AEC, while C. A. Thomas, executive vice-president of Monsanto, gained permission for his company. Parker has served as chairman of AEC.

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Franchise Renewal Granted

Picher, Okla., has renewed the electric franchise of Empire District Electric Co for 10 years. The company plans to change from 25 to 60 cycles.

H. S. FITCH, vice president of West Penn Power Co, who spoke at meeting of PEA Relay Committee, gets his briefing from Committee Chairman K. N. Reardon, center, West Penn Power. Vice Chairman F. S. Fehr, Metropolitan Edison, listens

New DC Calculating Board Features Described at PEA Relay Meeting

Postwar advances in standardizing design and production of electrical equipment will be a Godsend to the electrical industry in meeting the needs of our mobilizing national economy. H. S. Fitch, vice president of West Penn Power Co, in a speech before the Relay Committee of the Pennsylvania Electric Association expanded on this theme in urging maximum industry effort to meet these needs. He cited development and adoption of the unit substation, improved generating units, and other technical advances as proof of the industry's ability to continue to serve the nation. Attendance of 84 members and guests at the meeting in Pittsburgh, Feb. 15-16, was one of the largest in the history of the committee.

Design features of a new dc calculating board which combines the advantages of a fixed and a variable board were described in a paper by Otto Muhleisen and W. H. Osterle, West Penn Power Co. The company has built a board which represents the high and low voltage transmission systems, and which provides in addition a full section of circuit elements which can be combined with the system to study special conditions or any desired modifications. An additional feature is a separate battery which can be used to supply buck or boost voltage locally to simulate regulator or tap-changing transformer operation. This permits the direct determination of circulating currents for such operation.

One valuable function the board performs is to permit preliminary investigation of problems which are proposed for study on large ac boards. Valuable time which might be used in setting up unsuitable problems on the large board is thereby saved.

Operation of a new reclosing relay which combines the function of a single-shot and a multi-shot relay was described and demonstrated by L. E. Goff, General Electric Co. The relay provides for immediate initial reclosure by a preclosed contact or delayed initial reclosure without any mechanical changes. An internal means of blocking instantaneous tripping on first and subsequent reclosure simplifies relaying of systems including branch feeders with sectionalizing fuses. A definite-time reset feature following a successful reclosure eliminates many unnecessary lockouts or delays in reclosure, and allows more freedom in the selection of reclosure intervals.

Selective tripping has placed protection of low-voltage station auxiliary circuits in the same class as transmission circuits, without derating breakers, increasing equipment size, or use of relays, said L. L. Fountain, Westinghouse Electric Corp. He described the integral trip on each breaker pole with long time, short time, and instantaneous characteristics as the most economical and dependable protection available for station low-voltage auxiliary and other like systems.

In summarizing his discussion of directional relay element connections W. K. Sonneman, Westinghouse, concluded: (1) The general practice of shifting angle of maximum torque to approximately 45 deg leading for the 90-deg connection appears to give the best characteristic to fit the spread of possible phase angles, (2) a watt-type element appears to be best suited to the three remaining types of connections, (3) each connection theoretically involves the possibility of trouble in certain extreme cases, and (4) the 30-deg connection is not suited to systems of zero sequence source concentrated at opposite ends of a transmission line or to systems where a transformer bank is located between relay and fault.

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School Seeks Steam Plant

The University of Washington has asked the state legislature for $602,000 so it may generate its own electricity from steam. The school expects to lose the present favorable rate contract it enjoys with Puget Sound Power & Light Co when some of the company's properties are acquired by Seattle City Light. Large amounts of electricity will be needed for atomic energy experiments, and it is believed the university would save money if it had its own generator.

Short-Circuit Damage to Generator Rotors Is Discussed by EEI Group

Prevention of short-circuit damage to large turbogenerator rotors and the abandonment of the inhibited oil program by General Electric Co were major topics of discussion at the meeting of the Edison Electric Institute Electrical Equipment Committee in Cleveland Feb. 12 and 13. Other items were the announcement of a new storage battery and presentation of a program for fewer errors in system operation.

Inhibited Oil Suspended

DBPC supply is on the verge of being cut off because of extensive government needs for military purposes said H. M. Jalonack, adding that General Electric will suspend the furnishing of inhibited oil for transformers. It will not be resumed until the situation clears and there is decrease in number of utilities now unconvinced of the feasibility of operating with both inhibited and uninhibited oil to take care of transformers and breakers. The interval, he said, would afford fine opportunity for gathering experience on need, if any, for inhibited oil in breakers.

Damage to large generator rotors during short circuits was discussed in considerable detail by representatives of the three manufacturers. S. H. Mortenson and L. T. Rosenberg, Allis-Chalmers Manufacturing Co, attributed the rotor surface heating to the negative sequence MMF under single phase operation. They and J. B. McClure, General Electric, concluded that design margins at present are not excessive and that security calls for prompt clearing of line-to-line faults.

Cut in Time Standard Urged

M. D. Rose, Westinghouse Electric Corp, concurred and added that the 30 seconds of the early standards should be reduced to 2 seconds duration. Bartow Van Ness, Safe Harbor Water Power Co, said the big machines and big money involved might well warrant a 2-second limitation.

Second-line defense for generator clearing on the Public Service Electric & Gas Co, N. J., system is to be obtained, said D. W. Taylor, by double-coil solenoids, the second being supplied with 50% additional impulse for assured tripping. In discussion of a PEA Relay Committee report by R. S. Smithley, Duquesne Light Co, on practices in Pennsylvania, Taylor mentioned putting flywheel-motors on pulverizers to hold boiler flames until switchover is achieved.

A new calcium-alloyed lead storage battery was reported as under trial and development for floating service. For the subcommittee W. C. Bowen, West Penn Power Co, said the proponents claim the gravity may be 1250 or 1275 with higher output and elimination of trickle charge. Battery manufacturers generally are handicapped by the wide range of utility specifications with which they have to contend including the stipulated voltage for breaker solenoid operation.

Canadian developments reported by W. R. Way, Shawinigan Water & Power Co, included mention of a proposed new outdoor hydro plant by the Aluminum Co of Canada; the transformers will have aluminum windings. His company is installing 20-cycle reclosure on a one-, two- or three-phase basis after corresponding clearing.

Intensive campaigning on the New England Power System has reduced operating errors from 85 to 65 per year average for 1948-50. C. P. Corey, chief system dispatcher, said 85% were made by experienced men, almost half involved tripping wrong relay, jarring control equipment, etc, and 36 (more than half) exposed 19 men to possible injury. Down-to-earth, chatty (verging on "corny") pamphlets tell the men their faults in attention-holding style. Publicizing and penalties are eschewed. Self-preservation and public responsibility are emphasized in this year's campaign called "Operation Careful."

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Municipal Plant Closes

Cordell, Okla., has closed its electric plant and is buying its power wholesale from Public Service Co of Oklahoma. The city council has signed an agreement to buy all the city's energy requirements from Public Service for the next 10 years. The city plant will be kept for emergency use.

FPC Approves Contract Between Utility, SPA

The Federal Power Commission has approved rates and charges in a contract under which the output of Narrows Dam in southwestern Arkansas is being sold by the Southwestern Power Administration to the Southwestern Gas & Electric Co.

Southwestern G&E will purchase the annual output of the two-unit, 17,000-kw federal project for $207,000. The company will deliver to SPA up to 5,000 kw of capacity for resale by SPA to cooperatives. SPA will credit the company for these deliveries at a rate of 60¢ per kw per month and 4 mills per kwhr for power redelivered at the project site, with an additional mill per kwhr for energy delivered from the company's system.

Prior to the new contract filed last month, SPA sold most of the output of the plant to Southwestern G&E on a temporary, month-to-month contract. The utility has the only transmission line connecting the federal project.

In confirming the SPA-company contract, FPC said that its action "shall not in any way be considered an acceptance or endorsement by this commission of the allocation methods or the amortization of the power investment over a period of 100 years, used by SPA, or a final determination of the other questions set forth above."

FPC approval was for an interim period ending Feb. 13, 1952.

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Chapman Asks Rehearing of Roanoke Rapids Case

Secretary of Interior Oscar L. Chapman Feb. 19 asked the Federal Power Commission for a rehearing on the commission's Jan. 26 decision granting a license to Virginia Electric & Power Co for development of the controversial Roanoke Rapids site.

The license was approved last month after protracted hearings over a period of more than two years. Vepco proposes to build a $27-million, 91,000-kw hydroelectric plant at the site which Interior claims should be federally developed.

FPC, under its rules, has 30 days in which to grant or deny the request for a rehearing. If the commission does not act in that period, the rehearing is automatically denied.

Copper Order Relaxed on Builders, Tightened for Makers of Appliances

Makers of household appliances, refrigeration and air conditioning equipment lost and house builders won in NPA's newest copper order issued last week.

While NPA was again juggling its copper restrictions, a Congressional committee was told that the Munitions Board was considering a 50% cut in its purchases—from 26,000 tons a month down to around 13,000 tons. And Rep. James T. Patterson, Republican, Conn., was asking that a moratorium on copper stockpiling be considered to ease civilian supplies.

NPA copper experts don't believe the possible reduction of stockpiling would have any marked effect on the copper shortage. Demand is so far outrunning supply that they don't expect an easing of the situation until 1953.

In its newest order, NPA restored the use of copper for water systems in new houses, at least for a while. Builders had protested the original order, arguing that they couldn't get enough galvanized water pipe as a substitute.

About 50 items joined industrial and commercial refrigeration and air conditioning equipment on the newly banned list, effective April 1. Repair parts and functional parts are not included in the order.

Household electrical appliances are on the list, except operating parts for which copper specifically is required. Also on the list are such items as coffee makers, home and farm freezers, ice cream freezers and waffle irons.

The order relaxes controls over copper held in inventory. Items for which copper was banned in the order of Dec. 30 (List A) can now be made out of copper inventory on March 1, if the copper is unsuitable for articles not on the banned list. Copper not in inventory, but included on the producer's schedule for February and delivered before April 1, may also be used, under the same rules.

For the new list of banned items (List B) copper in inventory April 1 may be used if it is unsuitable for articles not banned. Copper scheduled for March and delivered before May 1 can be used under the same conditions.

Controls deliveries from producer or distributor.

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Depa Forms and Orders Sent to Utility Companies

Defense Electric Power Administrationtion (formerly Defense Power Administration) has issued six forms and two orders to electric utilities. Copies may be secured from the Defense Electric Power Administration, Department of Interior, Washington 25, D. C.

The forms were these:

DPA-1A—Receipts and use of aluminum conductor and busbars by quarters for 1950 and 1951.

DPA-1C—Receipts and use of copper for the same periods.

DPA-1S—Use of steel for the same periods.

DPA-2—Statement of a current or proposed construction project with estimated use of materials and equipment.

DPA-3—Statement of proposed use of aluminum, copper, and copper-base alloy for a construction project.

DEPA-3S — Statement of required shipments of iron and steel for a construction project.

The orders were as follows:

EO-1—Provided that Forms DPA-2 and DPA-3 must be filed by utilities for all "major plant addition" projects which will use aluminum, copper, or copper-base alloy on or after April 1. DEPA-3S is to be filed by March 1 for projects which require iron or steel in the third quarter. EO-1 is being amended to provide for use of DEPA-3S.

EO-2—Establishes broad rules governing utility requests to Depa for materials and equipment procurement assistance (EW, Feb. 12, p 89).

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Appointed to Utilities Body

Peter E. Mitchell has been appointed to the California Public Utilities Commission to succeed Ira H. Rowell, who has retired. Mitchell formerly was a member of the California Employment Stabilization Commission and served on the Sacramento City Council for nine years before entering state service. Rowell had served with the PUC since 1927 as examiner, assistant attorney, and chief counsel. He became a member of the commission in 1944.

Aid Offered on Release Of Technical Information

The Office of Technical Services of the United States Department of Commerce has set up a service to help businessmen guard against the release of technical information which may be of aid to potential enemies. In setting forth instructions for obtaining assistance from the Office of Technical Services the recently issued statement read as follows:

"It is not contemplated that persons in a position to release unclassified technical information will normally call on OTS for guidance regarding release to known representatives of recognized scientific and technical journals, radio networks, press associations, and newspapers. Most of these organizations have wide experience in safeguarding such material. However, the service will be available to both the editor and the source of the material if they desire to use it."

Industry M Orders

The following M orders of interest to the electrical industry have been issued by the National Production Authority. Orders not of interest have been omitted. Copies of these orders may be secured from the National Production Authority, Washington 25, D. C., or from any regional office of the Department of Commerce. (For earlier orders see EW, Feb. 19, p 14.)

M-16—Distribution of copper and copper-base alloy scrap: Limits to producers of copper raw materials the right to melt or process copper scrap originating in own plants. Bars large accumulations of such scrap. Regulates marketing of copper and copper-base scrap—as amended.

M-17—Electronic components or parts: Provides for equitable distribution of rate orders among manufacturers of certain electronic components.

M-19—Cadmium: Imposes inventory controls on cadmium. Limits use.

YIELDS (%) — Operating Electric Utility Securities

Quality	Bonds			Preferred Stocks			Common Stocks		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
DATE									
1950									
Feb. 15	2.66	2.67	2.77	3.80	4.00	4.46	5.34	6.20	6.97
Feb. 8	2.65	2.67	2.77	3.81	4.02	4.48	5.60	6.22	6.99
END OF QTR.									
4th 1950	2.65	2.67	2.78	3.86	4.14	4.51	5.80	6.54	7.44
3rd 1950	2.66	2.67	2.76	3.81	4.08	4.46	5.70	6.54	7.25
2nd 1950	2.68	2.66	2.74	3.79	4.03	4.38	5.38	6.51	7.50
1st 1950	2.59	2.61	2.74	3.78	4.01	4.36	5.22	5.85	6.67

Data: Reis & Chandler, Inc.

AP&L Announces Plan to Sell WWP; SEC Weighs Jurisdiction Question

The Securities and Exchange Commission will rule today (Feb. 26) on whether it will claim jurisdiction over the proposed sale of Washington Water Power Co by American Power & Light Co to public utility districts. Oral argument on the question was scheduled before the commissioners this morning in Washington, following simultaneous public hearings Feb. 20 in Spokane, Wash., and the capital.

American's notice of the proposed sale was filed Feb. 15, and SEC has only through Feb. 26 to claim jurisdiction. Hearings last week, before Commissioner Richard B. McEntire in Spokane and Commissioner Edward T. McCormick in Washington, were solely on this question. American contends the commission does not have jurisdiction under Section 2 (C) of the Holding Company Act, which states that the act's provisions shall not apply to public agencies.

The notice of proposed sale was filed with SEC only two days after press reports that American's president, Howard Aller, had denied that any sale plans for WWP were brewing (EW, Feb. 19, p 20).

In the notice American said it plans to dispose of all its interest in WWP by sale of stock or physical properties to PUD's and municipalities now served by the company. Net proceeds to American were estimated at between $56 million and $61 million in cash, U. S. Treasury bonds in amounts not to exceed $5 million, and PUD bonds not exceeding $15 million. American said the cost of its interest in the Washington subsidiary, plus surplus earnings accumulated under its control, was in excess of $68,350,000.

After completion of the sale WWP would be dissolved and American, which is under orders from SEC to sell the Washington property and dissolve, would distribute the cash proceeds to its own stockholders. About $2.7 million would be distributed to WWP employees under the subsidiary's retirement plan.

Estimated cost of reproducing the Washington company's physical properties, less accrued depreciation of 19.2%, is more than $126 million, according to American, or about $96.5 million for the common stock after deducting the cost of retiring WWP's bonds and preferred stocks and the satisfaction of its liabilities.

The notice said no commitments have been made but American believes there are reasonable prospects for such sales. The holding company proposes to negotiate the sales after Feb. 26.

At the Washington hearing American's proposals were sharply attacked by counsel for Electric Bond & Share Co, American's former parent which still holds 183,050 shares of American stock. Bond & Share charged that the sale notice was "an effort to obtain this commission's uninformed approval of a deal before its terms are disclosed." Noting that the notice contained no information on fees and commission to be paid, Bond & Share counsel said that "there have been recurrent rumors in the financial district to the effect that unconscionably high fees and commissions are to be paid: A fee as high as $5 million to the proposed underwriters, a fee of $1 million or more to an alleged promoter."

Bond & Share also challenged plans for disposing of WWP's Idaho properties, estimated at a fourth of the value of the utility. Counsel said large portions of the company's Idaho properties are located outside the municipalities it serves and there are no PUD's in Idaho.

American's statements on WWP's earnings and value were termed "inaccurate and misleading" by Bond & Share. American, it was contended, "has consistently underestimated the earning power of its subsidiaries." In 1948 proceedings before SEC American estimated WWP earnings at 30% less than actual earnings for 1950. Also cited was the sale last year of the stock of Pacific Power & Light Co for $16,125,000. "At current prices the value of the Pacific common stock is approximately $25 million," Bond & Share said.

FINANCIAL BRIEFS

The city of Pryor, Okla., has agreed to purchase the present Public Service Co of Oklahoma distribution system there for $265,000. Money for the purchase came from W. A. Graham, local banker, who gave the city $100,000 for the purpose (EW, Jan. 22, p 14) and bought its $180,000 bond issue at a 1% interest rate. Originally the council had offered the company $250,000 for the facilities.

Vivien Kellems will get back penalties levied against her when she refused to withhold taxes from employees of her Stonington, Conn., factory, a federal court jury has decided. The trial climaxed Miss Kellems' three-year battle against the withholding tax law. She claimed the right to refuse to be a "tax collector" under the law. The favorable jury verdict entitles her to recover $6,133 seized by the internal revenue collector as a penalty.

National Power & Light Co has sold its interest in Lehigh Valley Transit Co to Cincinnati, Newport & Covington Railway Co for $810,500. This disposed of the last operating subsidiary of National, a subsidiary of Electric Bond & Share Co. National's only remaining assets consist of cash and 34,146 shares of Pennsylvania Power & Light Co common stock.

Anti-Smoke Group Moving

Headquarters of the Air Pollution and Smoke Prevention Association of America, Inc, is being moved from Chicago to Pittsburgh. It will be housed in Mellon Institute, which has pioneered in research on urban and communal smoke since 1911. Announcement was also made of the appointment of Robert T. Griebling, a fellow of Mellon Institute, as executive secretary.

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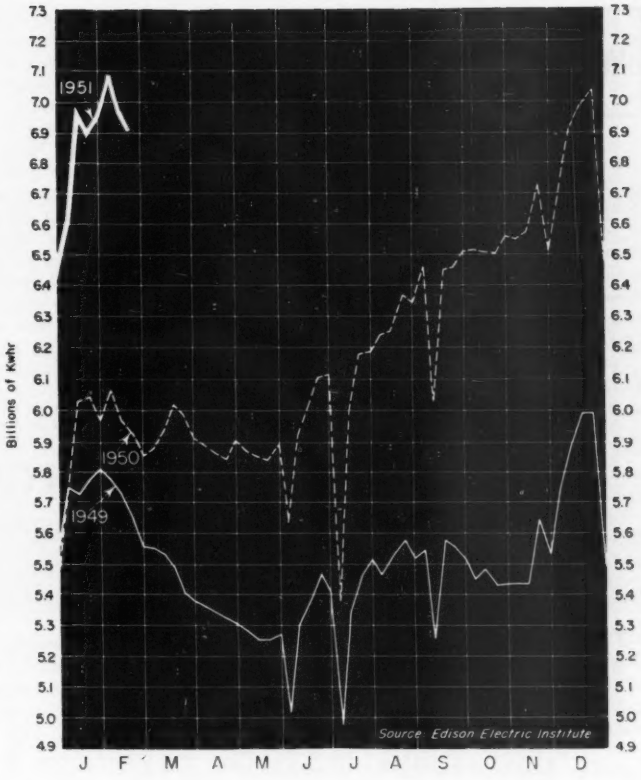
Iowa Utility Orders Unit

Iowa Power & Light Co has ordered a 66,000-kw generator for its plant in Des Moines. The installation is expected to be completed by the summer of 1953. The new unit will increase the plant's capacity to 150,000 kw. making it the largest generating plant in Iowa.



Output Week Ended Feb. 17—6,905,223,000 Kwhr

Weekly Output, Millions Kwhr

1951		1950		1949	
Feb	17 6,905	Feb	18 5,931	Feb	19 5,650
Feb	10 7,957	Feb	11 5,971	Feb	12 5,722
Feb	3 7,099	Feb	4 6,062	Feb	5 5,778
Jan	27 6,970	Jan	28 5,972	Jan	29 5,810
Jan	20 6,909	Jan	21 6,041	Jan	22 5,769
Jan	13 6,981	Jan	14 6,029	Jan	15 5,727
Jan	6 6,602	Jan	7 5,695	Jan	8 5,742
1950		1949		Jan	1 5,562
Dec	30 6,479	Dec	31 5,493	1948	
Dec	23 7,033	Dec	24 5,994	Dec	25 5,508
Dec	16 6,985	Dec	17 5,997	Dec	18 5,790

Percent Change from Previous Year

	Feb 17	Feb 10	Feb 3
New England	+13.3	+13.8	+16.7
Mid-Atlantic	+14.5	+15.6	+16.8
Central Industrial	+18.4	+17.3	+19.5
West Central	+16.3	+16.4	+16.4
Southeast	+18.4	+24.5	+23.1
South Central	+20.7	+14.7	+15.3
Rocky Mountain	+10.4	+ 8.2	+ 7.5
Pacific Coast	+14.3	+11.4	+10.7
Total United States	+16.4	+16.5	+17.1

MEETINGS

Pennsylvania Electric Association
Electrical Equipment Committee, Hotel Emerson, Baltimore, Md., March 1-2; Prime Movers Committee, Berkshire Hotel, Reading, Pa., March 8-9; Joint Meeting of Electrical Equipment, Transmission and Distribution Committees, Abraham Lincoln Hotel, Reading, Pa., May 10-11.

American Society for Testing Materials
Spring Meeting, Netherland Plaza Hotel, Cincinnati, Ohio, March 5-9; Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J., June 18-22.

★Interstate Power Club of New York
Hotel Martiniaue, New York City, March 12.

National Electrical Manufacturers Association
Annual Meeting, Edgewater Beach Hotel, Chicago, Ill., March 12-15.

National Association of Corrosion Engineers
Conference and Exhibition, Hotel Statler, New York, March 13-16.

Protective Relay Engineers
Annual Conference, Agricultural & Mechanical College of Texas, College Station, Texas, March 26-28.

Oklahoma Utilities Association
Annual Convention, Mayo Hotel, Tulsa, Oklahoma, March 29-30.

Southeastern Electric Exchange
Engineering and Operation Section, Vinoy Park Hotel, St. Petersburg, Fla., March 29-30; Annual Conference, Boca Raton, Fla., April 11-13.

Edison Electric Institute
Annual Sales Conference, Edgewater Beach Hotel, Chicago, April 2-5; Purchasing and Stores Committee Annual Conference, Lord Baltimore Hotel, Baltimore, Md., April 30-May 2; Meter and Service Committee, jointly with Association of Edison Illuminating Companies Committee on Metering and Service Methods, Huntington Hotel, Pasadena, Calif., May 7-9; Commercial Electric Cooking Conference, Sheraton Hotel, Chicago, Ill., May 9; Electrical Equipment Committee, Hotel Biltmore, Los Angeles, Calif., May 28-29; Annual Convention, Shirley Savoy Hotel, Cosmopolitan Hotel, Denver, Colo., June 4-7.

American Society of Mechanical Engineers
Spring Meeting, Atlanta Biltmore Hotel, Atlanta, Ga., April 2-5; Semi-Annual Meeting, Royal York Hotel, Toronto, Canada, June 11-15.

Electric Association of Chicago
Industrial Electrical Exposition, Sherman Hotel, Chicago, Ill., April 2-7.

Midwest Power Conference
Sherman Hotel, Chicago, April 4-6.

Missouri Valley Electric Association
Engineering Conference, President Hotel, Kansas City, Mo., April 4-6; Accounting Conference, President Hotel, Kansas City, Mo., May 17-18.

Indiana Electric Association
Young Men's Utility Conference, Ipalco Hall, Indianapolis, April 10-11.

★American Institute of Electrical Engineers
District No. 4 Meeting, McFadden-Deauville Hotel, Miami, Fla., April 11-13; District No. 1 Meeting, Hotel Syracuse, Syracuse, N. Y., May 2-4; District No. 5 Meeting, Loraine Hotel, Madison, Wis., May 17-19; Summer General Meeting, Royal York Hotel, Toronto, Canada, June 25-29.

Northwest Public Power Association
Annual Convention, Cascadian Hotel, Wenatchee, Wash., April 12-14.

Rocky Mountain Electrical League
Annual Spring Conference, Shirley Savoy Hotel, Denver, Colo., April 15-18.

Northwest Electric Light & Power Association
Engineering Section, Hotel Utah, Salt Lake City, Utah, April 25-27; Business Development Section, Multnomah Hotel, Portland, Ore., May 7-9; Personnel Section, Davenport Hotel, Spokane, Wash., May 16-18.

New Jersey Utilities Association
Spring Meeting, Seaview Country Club, Absecon, N. J., May 4.

American Public Power Association
Annual Convention, Read House, Chattanooga, Tenn., May 7-9.

Missouri Association of Public Utilities
Annual Convention, Jefferson Hotel, St. Louis, Mo., May 7-9.

Pacific Coast Electrical Association
Annual Convention, Biltmore Hotel, Los Angeles, Calif., May 21-23.

Canadian Electrical Association
Annual Convention, Algonquin Hotel, St. Andrews, New Brunswick, June 18-20.

★ Addition this week

WASHINGTON COMMENT

RONALD D. ROSS

One of the best suggestions for saving critical materials and using the nation's power resources to most advantage in the days ahead has come in a statement by the Secretary of Interior. Chapman, in whose department the Defense Electric Power Administration continues to reside, wasn't making a policy pronouncement. He was merely commenting, for purposes of a press release, on a new contract between the Bureau of Reclamation and the Montana Power Co. (EW, Feb. 12, p 90).

Under terms of the agreement, power from Reclamation's Canyon Ferry Plant will move over the company's lines between East Helena and Great Falls, Montana.

"This contract which eliminates the necessity for construction of a separate federally owned transmission line is definitely in the interest of public service and defense," the secretary said, adding "It enables conservation of critical materials and also assures adequate transmission facilities for the 50,000 kw of power which are expected to be available at the Canyon Ferry Plant by the fall of 1953."

Line Would Have Used Scarce Materials

Specifications for the line, the press statement explains, called for a million lb of aluminum cable, 1,300 poles, and 20,000 insulators, among other things. Of course, making these materials available won't ease the pinch or make tight supplies less critical, but every pound of aluminum these days promises to be important. More important, perhaps, is the other side of the story. Here were miles of aluminum cable and other materials scheduled to be expended needlessly for duplicating lines, according to the apparent admission of the Secretary of the Interior. Nor is this mere theorizing or speculation. Bids already had been accepted for construction of the duplicating line. Fortunately, they can be cancelled.

The Canyon Ferry line wasn't very large in the national power picture, nor even in the extensive plans on Reclamation drawing boards. However, its embryonic death deserves more than passing mention. It would seem to offer a lesson on power planning—especially in a period of mobilization marked by shortages of construction materials.

Other Duplicating Lines Can Be Eliminated

We respectfully suggest that Secretary Chapman, for one, might contemplate the broader aspects of the Canyon Ferry story, particularly in the light of his own words on the subject. How many more Canyon Ferry lines—needlessly duplicating private electric utility facilities are being planned by the department's power empire builders? The Canyon Ferry contract, plus growing numbers of other agreements between Interior power agencies and private utilities, would seem to indicate that there are even more unnecessary lines that could be chopped out of federal power programs. The advantages of curtailing any duplicating facilities should be particularly obvious to Chapman in his newer role in the defense power program. Depa, which must soon pass on the relative importance of proposed power projects, will want to remember Canyon Ferry. Contracts use plentiful paper rather than aluminum or copper.

Congress which appropriated funds for construction of the Canyon Ferry link now is told that the line wasn't necessary after all. Congressmen may well inquire how many tons of scarce materials are proposed to be expended on other duplicating transmission lines for which Interior is asking funds.

And on the subject of funds, $365,000 was appropriated last year to start construction of the $1,169,970 Canyon Ferry line. This sort of saving shouldn't be overlooked in adding up the advantages of cutting back federal transmission construction.

TECHNICAL NOTES

ARCHER E. KNOWLTON

Aluminum foil on flat-topped pole prevents woodpecker damage by preventing insect entrance.

Pole replacements of a 500,000-pole utility average 2.65% yearly because of a 38-year program of creosoting; only 0.01% failed last year, others were broken by crashes or removed for other cause.

Service and service drop wires perform practically identical functions and meet much the same exposures; why separate specifications?

Obsolescence of old 5-amp watthour meters should be based on: (1) Comparative maintenance, (2) thermal characteristics, (3) retained light load registration, and not on casual detection of dials discolored by overload.

Horizontal contouring of a coal pile gives better accuracy of volume estimate than vertical sectioning; air stereophotos are better yet.

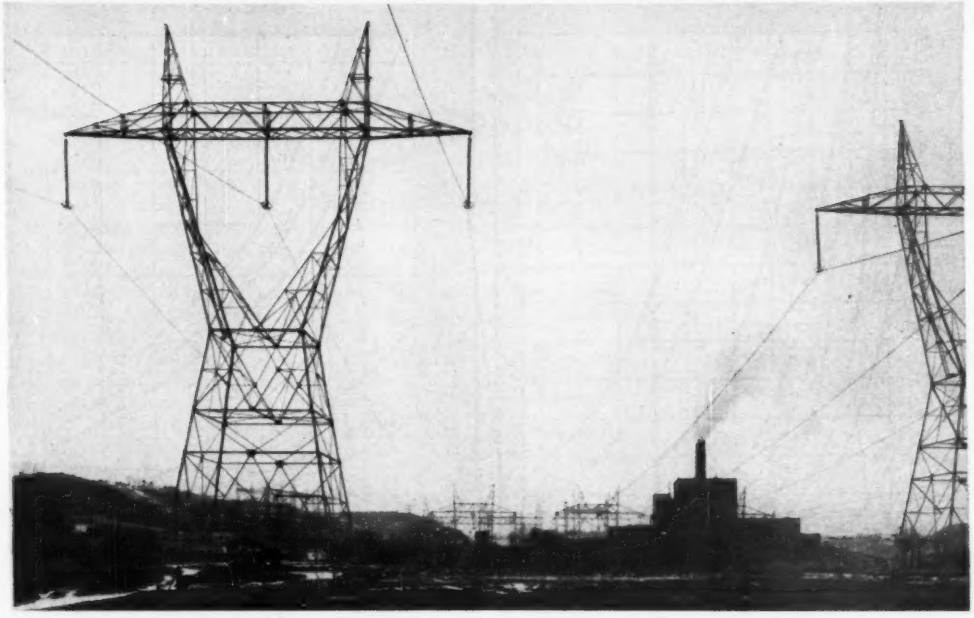
Charred current coils are constituting 20% of the 35-amp watthour meter inspection reports of some companies.

Telemetering transmission can be achieved by optical, sonic and hydrosonic as well as pilot, carrier and microwave links.

Station communication is important in emergencies at centralized control plants; the battery is a good source for powering it.

Inadequate chemical treatment of brush is a sign of incompleteness rather than inherent ineffectiveness.

Flux density is not uniform around the corner of a transformer core and there is, further, a distortion of wave form.



TIDD TEST LINE that provided the basic performance data on extra high voltage transmission line performance. In background are Tidd generating station and the test station where three single-phase 66/265–500 kv transformers are located

Loading, BIL, and Glaze Melting Favor 315 Kv for AG&E Line

Corona, radio interference, live-line maintenance, economic loading, tower height, stringing factors likewise converge on 1.6-in. expanded aluminum conductor with steel core

PHILIP SPORN, E. L. PETERSON, I. W. GROSS and H. P. ST. CLAIR
American Gas & Electric Service Corp, New York, N. Y.

The extra high voltage transmission system designed to provide the increase in transmission requirements of the American Gas & Electric Co power system presents the fruits of a major and extensive research project in transmission. The resulting system, it is believed, is in consequence unique not so much from the standpoint that the voltage is higher than any that has been utilized or projected heretofore in the United States, but more notably by the fact that the basic ideas and the designs developed have been based on detail data and much information unavailable previously and made available directly by the research. Aided by this, the margins of safety in insulation strength, and in factors of safety in general could, therefore, be brought down, and were brought down, to within relatively narrow limits of the zones of absolute requirements.

Condensed from "The 300/315-kv Extra High Voltage Transmission System of the American Gas & Electric Company" presented at AIEE Winter meeting.

Transmission Need . . . Need for greater transmission capacity is brought about by:

1. The necessity of carrying larger blocks of load to load centers even though the distances involved preclude classing the lines as long distance transmission lines.

2. The necessity of shifting generation from one plant to another both for emergency and for economy reasons.

3. The required ability to transmit loads from points of over-balance between generation and load and point of deficiency during relatively brief but

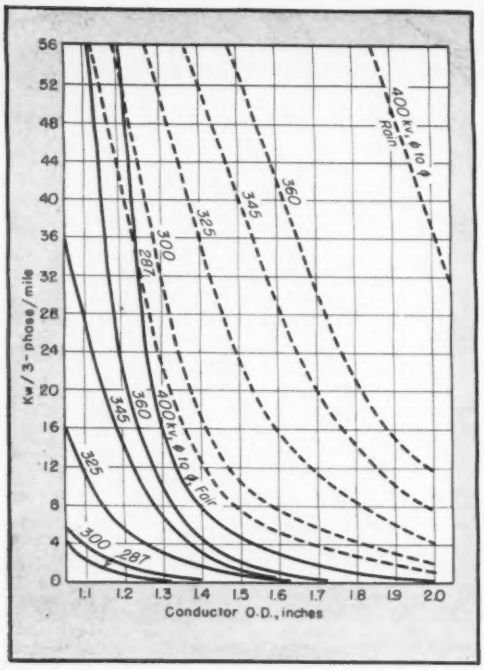


FIG 1—TYPICAL 3-PHASE CORONA LOSS vs conductor diameter and line voltage. Solid lines on the graph are fair weather averages; the dashed-line is for rainy weather

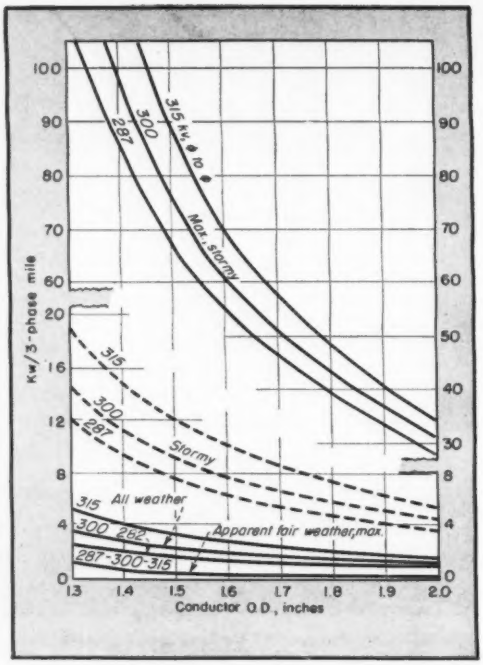


FIG 2—TYPICAL 3-PHASE CORONA LOSS vs conductor diameter at 287, 300 and 315 kv. It is readily apparent that the losses increase enormously during storms

frequently occurring periods as a result of carrying on expansion and construction in relatively large blocks at successively different points on the system.

4. The need to restore flexibility in the basic transmission system which to a considerable degree has been lost due to system loads and generating units outgrowing the present 138-kv system.

5. The fact that necessary expansion of transmission capability at the present 138-kv level is becoming more difficult all the time because of the multiplicity of rights-of-way required. These difficulties, it appears almost certain, will grow into almost insurmountable obstacles as densities of load and of population increase, and particularly as centers of transmission originally developed in relatively sparely settled areas become more thickly populated.

6. The obligation to provide for the needs of national defense.

7. The pressing, almost imperative, need to take measures designed to counterbalance in part or in whole the natural increase in cost at a given voltage as system size grows and as areas grow and develop, and the abnormal increases in cost as a result of the postwar rise in cost of basic materials, labor, and equipment.

Decision . . . It was concluded that the new transmission lines should be double-circuit construction rated tentatively at 300 kv (315-kv maximum), and using a 1.6-in. diam conductor and all other design features suitable for a 315-kv nominal rating, 330-kv maximum. As will be described later, all insulation requirements, including line units, transformer BIL's, etc, have been based on the 315-330-kv level.

Glaze Melting . . . One consideration brought into the problem of voltage selection is the glaze problem which is a very serious one in a large part of the territory covered by the American Gas & Electric Co system. Based upon experience* and upon weather records in the area concerned, it has been concluded that the design of the new high-voltage system must be such as to permit glaze melting, if not in the first stages, at least in the system as it becomes fairly well developed. Obviously, since both the conductor diameter and the conductivity necessarily go up as the voltage level is increased, the glaze-melting problem will likewise become more and more difficult and may constitute a practical limit to the voltage level selected.

Hot-line Work . . . Another important consideration in keeping lines in service is the use of hot-line maintenance procedure. On the present 138-kv system this is considered a necessary routine and in order to maintain maximum service continuity on the higher voltage system, it will be highly desirable to be able to retain this practice. While it may not be feasible to continue such practices if and when much

* "Normal Voltage Short Circuiting Removes Conductor Glaze" By Philip Sporn, "Electrical World," May 20, 1939, pp. 40, 41, 105.

higher voltages are used, nevertheless, it is believed entirely practicable to use hot-line maintenance in the range of voltages under consideration for this project.

A 315-kv double-circuit line appears not to involve so great a capacity concentrated in any one route that the voltage would have to be rejected for that reason.

Corona produces two adverse effects: First, energy loss* which must be kept within economic limits, and second, radio influence in areas adjacent to the line, which again must be held within tolerable limits, keeping in mind the type and character of populated areas where high voltage lines will most likely be built.

Both of these features, corona and radio influence, increase rapidly as line voltage is raised for any size, type and arrangement of conductors within practical limits.

Distance Limits . . . For a system such as the one studied, while the overall length of the high-voltage system will be quite large, the effective transmission distance involved in any one line element will vary from a maximum of about 175 miles down to 50 miles or less. The load carrying capability per circuit of these lines will, therefore, range from around 1.5 times surge impedance loading for the longest line, up to at least 2½ times surge impedance loading for the shortest. At 287 kv this gives 300 to 500 Mw, whereas at 345 kv it would be 450 to 750 Mw. This means that the 175-mile line capability limit is stability and the ability to hold voltage and supply the reactive loss in the line (approximately 125,000 kvar at 345 kv and 450 Mw), whereas the 50-mile line limit may be a matter of thermal capacity of conductors as well as reactive loss. For example, the line currents associated with these limits for the 50-mile line loading would be about 1,000 amp and 1,250 amp, respectively, for 287 kv and 345 kv.

Double-circuit . . . From the power flow studies adequate transmission capacity was provided by any of the voltages tried, ranging from 287 kv to 360 kv; but the main difference was that 287 kv required double circuits on some of the lines, whereas single circuits were adequate throughout with 345 kv or 360 kv. This naturally, brought out the fact that the capability of a 287-kv double-circuit line exceeds that of a 345-kv single circuit by 38% and 360 kv by 27%.

Interference . . . Corona and radio influence particularly played a very important if not decisive part in the final selection of voltage level. Corona losses as such are of interest and the economics of corona loss will be discussed later, but they were definitely not a determining factor in selecting the system voltage.

To facilitate evaluation of the radio influence factor, a summary of representative data shows the following:

Rated Line Kv	Con. Diam Inches	Approx. RI μv/Meter
138	0.5	15
230	1.15	15
287	1.4	25
300	1.6	17
315	1.6	25
345	1.8	25
360	1.9	25

Conductor Size . . . It was immediately evident that an excessively large and unwieldy single conductor would be necessary with a voltage level as high as 360 kv, or even 345 kv, if radio influence were to be maintained at a reasonably low level. Bundle conductors were considered, but ruled out rather early in the project because of complication and expense introduced in stringing, sleet melting, hot-line maintenance, high tower costs, etc.

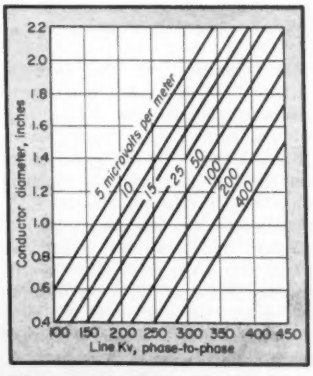


FIG 3—RADIO INTERFERENCE effects 100 ft from under-conductor for typical lines during fair weather

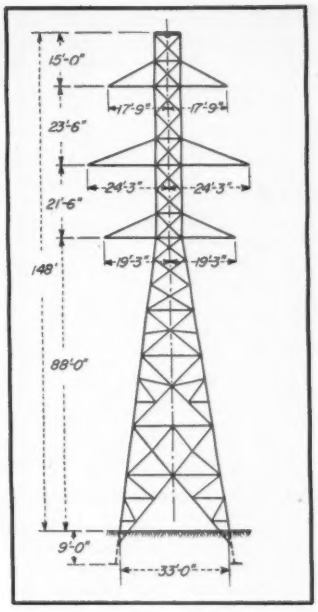


FIG 4—TOWERS are to be double circuit, 148 ft high with 33 ft square base. Similar pattern for the 138 kv towers had 100-ft height and 22-ft base

These results, therefore, tended to discourage the adoption of the higher voltage single-circuit idea and to favor more than ever the use of double-circuit lines at a more moderate voltage.

While the final decision on voltage level was thus based largely on radio influence and other considerations described above, corona losses and their economics were also carefully analyzed.

With a conductor O.D. of 1.6 in. and a line voltage of 315 kv, the maximum apparent fair weather loss is 0.2, the all weather loss 1.8, the storm weather loss 10, and the maximum storm weather loss 69 kw per 3-phase mile of line (Fig 1 and 2).

While widespread storm conditions involving considerable line mileage could produce corona loss increasing system demand, it does not appear that the increase would be significant or burdensome with a 1.6 in. or even a somewhat smaller conductor. The high probability of diversity between the rather infrequent occurrence of such a system condition simultaneously with a monthly or

* For curves see Engineering Reference Sheet No. 51 on page 104.

TABLE I—Basis for Determining Line Insulators For 315-Kv Rated System

(Factors or Margins Added to Obtain Requirements)

	Factors For	
	60 Cycle[1] rms, Wet	Switching[2] Surges
Max. Operating Voltage Times Rated	1.05	1.05
Line Faults	1.20	....
Switching Surge	....	2.8[3]
Critical Impulse to Switching Surge	....	1.15
Contaminated Atmosphere	1.40	1.10
Wet Flashover vs Dry	....	1.0
Withstand vs Flashover	1.15	1.15
Non-Standard Atmosphere	1.10	1.10
Factor of Safety	1.50	1.15
Use of Grading Shields	1.00	1.00
Crest Factor	....	1.414
Defective Insulator	1 Unit	1 Unit
Hot-line Maintenance	1 Unit	1 Unit
Overall Factor	3.35 ÷ 2 Units	7.7 ÷ 2 Units
Applied to	60-cycle rms F. O.	Critical Pos. Impulse F. O.
Resultant No. 5 3/4x10-in. Units	17 1/3	17 1/3
Insulators Selected	18	18

Notes:
[1] Based on wet 60-cycle flashover (F.O.), rms.
[2] Based on critical impulse and crest of 60-cycle.
[3] Based on one arc restrike in breaker.

TABLE II—Comparative Insulation Characteristics Of Various Extra High Voltage Lines

	Hoover-Los Angeles	Sweden[1]	AG&E Co
Rated line kv, phase-to-phase	287	380	300/315
No. 5 3/4-in. insulators	21[4]	23[4]	18
60-cycle dry flashover, kv	1,100	940[2]	965
60-cycle wet flashover, kv	780	760[2]	690
Impulse flashover, kv	1,825	1,560[2]	1,585
Cond. Clearance to tower, ft	9		7 3/4
At Angle of, deg	30		35
Impulse Flashover	1,655		1,430
Cond. tower clearance, vertical, ft	.....	.....	13
Max. shielding Angle of G. W., deg	38		33.5
Phase separation, ft	24.5/32.5[5]	39	21.5/35.6[5]

[1] CIGRE Report 410, 1940—Swedish Line.
[2] Withstand Values.
[4] First figure, vertical; second, horizontal between conductors.
[5] First figure, vertical between conductors; second, horizontal between circuits.
[6] Equivalent 5 3/4-in. units.

yearly peak system demand would seem to preclude evaluating such a loss in terms of investment in generating capacity.

Corona Economics . . . On a 315-kv line an increase in conductor diameter from 1.6 to 1.65 in. shows the annual savings in corona loss (using energy at $0.0025/kwhr, and annual charges at 16.25%) would justify an increased investment of only $94 per mile. Since this amount would be far less than the actual cost of installing the increased conductor diameter, it is obvious that the annual integrated corona loss is not a determining economic factor.

The final conductor design will be 1,269.3 Mcm ACSR, or 798.3 Mcm copper equivalent, 1.6 in. diam, and 1883.6 lb per thousand ft. It will have two layers of 0.1546-in. diam aluminum strands, 28 and 22 strands in the first and second layers respectively, and a steel core of 19 strands of 0.0874 in. The 1.6 in. diam was obtained by incorporating between the aluminum and the steel core, a filler, consisting of two layers of twisted treated paper twine, 12 strands in the outer and 8 in the inner layer, and in addition, two aluminum wires in each paper layer to increase the compression strength of the cable. Ultimate strength will be 41,970 lb.

System Overvoltages . . . The studies on the proposed high voltage system indicated no more than 18% 60-cycle overvoltage, that is, above a maximum operating level of 330 kv as tentatively set.

Switching surge voltages were found to be of the following:

No. of Breaker Arc Restrikes	Switching Surge-Times Max. Normal Voltage to Ground
0	2 to 2½
1	2.8
2	3.2
3	3.3

Although an essentially non-restriking type of breaker may be used, nevertheless it was felt that it would be wise to allow for one restrike, which would mean a switching surge transient of 2.8 times normal line-to-ground voltage.

Line Insulation . . . As the 300/315-kv system will be solidly grounded, the 60-cycle requirements will be based on the rated line-to-ground voltage. During system faults this voltage will increase momentarily until the fault is cleared. Calculations on the ultimate system in question indicated this might increase to 1.18 times normal. A rounded figure of 1.20 was used in this study.

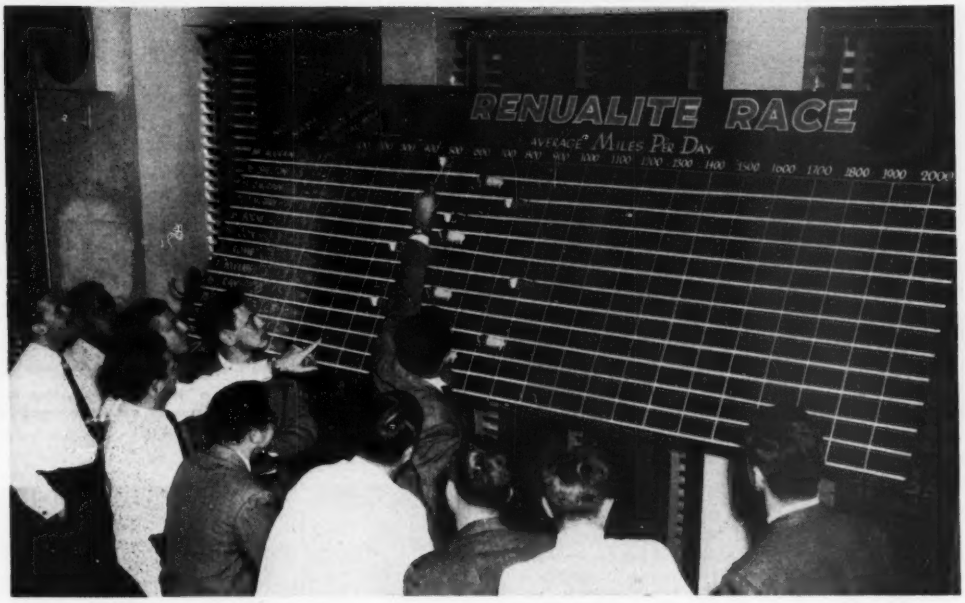
Other considerations include margins, or factors, for such features as contaminated atmosphere, insulator withstand voltage vs flashover, non-standard atmospheric conditions, and an over-all factor of safety of 50%. The factors used for the various items are given in the first column of numbers in Table I. Applying these factors to the published values of wet flashover of standard 5¾ x 10-in. insulators gave the required number of units. One extra unit was then added to provide against a unit in a string becoming defective in service, and another unit was added as an additional protection for hot-line maintenance. This resulted in 17⅓ units—or the practical figure of 18 units. The wet flashover voltage of 18 units is 3.8 times the 60-cycle rms line-to-ground voltage of a rated 315-kv system.

Both 60-cycle and switching surge considerations gave the same results, namely 18 5¾ in. insulators per string.

Lightning . . . Assuming 18 5¾-in. insulator units, tower footing resistances not to exceed 20 ohms, and a ground wire separation in midspan of 48 ft, the line lightning flashovers per 100 miles of line per year has been determined for an isoceraunic level of 45 as 0.3, or one in three years.

Tower Design . . . Studies on system load requirements resulted in a decision to utilize double circuit towers on the first link of the high voltage network. This first link will extend

(*Continued on page* 148)



CONTEST SCOREBOARD on morning of fourth day of the campaign. Salesmen gathered at board to see progress. Each sale equaled 100 miles of driving. The board shows an average of four to nine sales a day at this stage of the campaign

Lighting Adapter Campaign Builds Over $12,000 Revenue

Low-use customer load building campaign, using 12 residential contact representatives, sells 4,700 150-w lighting adapter units on 6,251 contacts—increases lighting load 382 kw

H. A. MULLIN, Sales Promotion Division
New Orleans Public Service, Inc, New Orleans, La.

When a lighting adapter merchandising campaign was held in New Orleans recently by a group of residential contact representatives who ordinarily do very little merchandising, the campaign got off to a slow start. But once the enthusiasm of the salesmen caught fire, the campaign blazed into an astounding success, setting sales records in New Orleans on this type of activity.

Ordinarily merchandised as kitchen lights, 4,700 lighting adapter units, were sold by 12 men, even though a few of them had their two weeks vacation during the campaign period. These 4,700 units were sold on only 6,251 contacts—an average of one sale for each 1.34 sales calls!

The campaign, held at New Orleans Public Service, Inc, was directed towards building up the electric load of that very important market, the low-use customer. The method used to build load was a sales campaign which merchandised an enclosing globe lighting adapter unit, having a 150-w lamp. This unit is designed to replace the bare 60-w lamps which many low-use customers in New Orleans use. The lighting adapter unit can be screwed into any dropcord or ceiling lamp receptacle, and the brighter, softer light from its 150-w lamp and glass diffusing globe adds beauty and better see-ability to almost any room in a home.

Since we do not merchandise major appliances, and have only occasionally merchandised home lighting equipment in the field since World War II, many of the contact representatives participating in the campaign had little experience in direct selling. These men ordinarily call on residential customers in the city and sell the advantages and benefits of our service. When a customer's

SALESMAN Owen Murphy, eyeing grand prize, plans his day

LET'S FOLLOW Salesman Murphy as he offers the lighting adapter unit to a prospective customer

1 HE GAINS ENTRANCE after a "How do you do, Mrs. so-and-so, I'm from NOPSI." Customers are accustomed to regular calls from utility representatives

interest in a new appliance had been stimulated by the contact man's selling, she is asked to sign a dealer lead card and designate a dealer of her own selection. The lead card is turned over immediately to the dealer specified who follows up on the prospect. Local dealers have been most appreciative of this system, and are very complimentary on the quality of the leads. During 1950 over one out of three of the leads developed into sales shortly after they were turned over to the dealers.

Since the campaign was held during the regular vacation period, it was decided to base the cash awards on the best average sales per day, with 20 days set as a minimum, allowing the men to miss two of the six weeks and still qualify for prizes. This award system was advantageous because it emphasized consistency. The men kept plugging for a good daily average, which greatly added to their over-all sales totals.

4 TAKING LEAVE after friendly visit whether or not customer buys fixture, main job of representative is to sell service and good public relations for the company

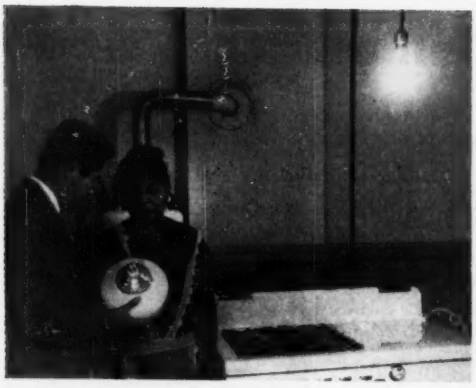
Lighting Adapter Campaign Statistics
August 21, 1950–October 13, 1950

Sales data and statistics	
Contacts	6,251
Adapters sold	4,669
Increased load (kw)	381.8
Man days (excluding supervisor), 12 men	369
Man days (including supervisor)	386.5
Sales ratio	
Average contacts per adapter sold	1.34
Average increased wattage per adapter sold	81.78
Average contacts per man day (excluding supervisor)	16.9
Average adapters sold per man day (excluding supervisor)	12.7
Average increased wattage per man day (excluding supervisor)	1,034.7
Expense and estimated annual revenue data	
Direct expense (salary and auto allowance)	$5,339.91
EAR from increased wattage	$12,386.16
Expense and EAR ratios	
$ expense per contact	$ 0.85
$ expense per adapter sold	$ 1.15
$ expense per man day (including supervisor)	$13.81
$ EAR per adapter sold	$ 2.64
$ EAR per $ expense	$ 2.31
Gross profit from sales	
Revenue from sales of adapters	$8,871.10
Less cost of adapters	$6,224.04
Gross profit from sales	$2,647.06
Ratio of expenses to revenues	
Excluding merchandise gross profit (EAR divided by direct expense)	1 to 2.3
Including merchandise gross profit (EAR divided by direct expenses less gross profit)	1 to 4.6

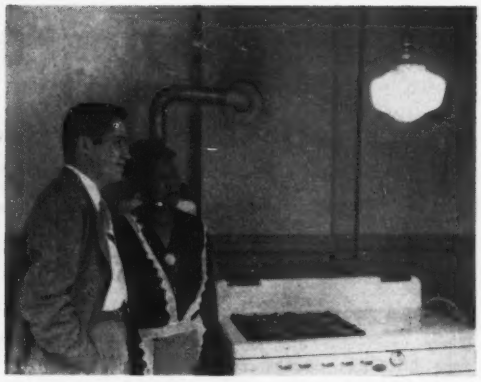
After the introductory fanfare, the campaign got underway. It was tagged the "MPD Race" and credit for 100 miles of driving was given for each sale, with prizes awarded on the best average "Miles Per Day." An average of 500 miles per day was established as the minimum qualification for prizes.

The campaign started at its predicted pace. The men averaged between four to nine sales per day for the first few days. Then came the first change. The mounting enthusiasm of the men became apparent as they began gathering around the giant sales scoreboard mounted in a prominent place in the office. Their competitive spirit and enthusiasm was aroused, and sales figures began to climb—then to zoom! Eagerness and excitement keynoted the next week as the salesmen hustled to outsell each other.

The enthusiasm grew as the campaign progressed and on the final days of the campaign there was an all-out



2 **INSIDE THE HOME** he unveils the lighting adapter unit and tells the customer that fixture will not only increase the see-ability but will also add beauty to the room



3 **HE DEMONSTRATES** the unit after installing it on a drop cord in place of a bare 60-w lamp. Customer is sold upon seeing what the new fixture does for her room

5 **CONTEST WINNER** Owen Murphy, with an average of 21 sales per day, points to the racer denoting his sales record. He attributes much of his success to advance planning. A few moments of preparation each day saved him hours in the field

drive to catch up with representative Owen Murphy who had moved into the lead in the race with an average of 21 sales per day. The racer on the scoreboard bearing his number was actually running off the board in keeping up with his sales. Murphy maintained the average to the end, finishing as grand prize winner.

The results of this campaign have proved again the value of selective load building activities. They also proved that an enthusiastic reception generally awaits the door-to-door salesman who displays initiative, industry and sincere customer interest in his work.

Increased lighting load of 382 kw amounting to over $12,000 of estimated annual revenue was added to our lines. Excluding merchandise profit, the ratio of expenses to revenue, including salaries, automobile expenses and supervision, was 1 to 2.3. Including merchandise gross profit, the ratio of expenses to revenues was 1 to 4.6.

Owen Murphy is typical of the salesmen in the contest. The average age of the contestants was in the low twenties and almost all had less than two years experience at the company. Murphy is twenty-five with a year and a half of experience. Murphy has a wife and two children and is a senior in night school at the Tulane School of Commerce and Business Administrations.

Sequential Motor Pull-In Underlies the Be

Author sees problem of service restoration after long outage becoming more troublesome. In considering possible remedies he examines theoretical circuit behavior; compares it with data on actual circuits

CHASE HUTCHINSON, Ebasco Services, Inc, New York, N. Y.

Bitter experience has taught that some distribution circuits can be re-energized, after prolonged outage, only by sectionalizing them and re-energizing a small part at a time. This process is often long and can greatly increase outage time. However, other circuits can be re-energized if relay settings are high enough to prevent trip-out, or if normal protective devices are bypassed.

With growing loads, particularly motors, the re-energizing current for some of these circuits may become greater than practical protection levels. There is ample reason to foresee that the problem of re-energizing distribution circuits may become troublesome.

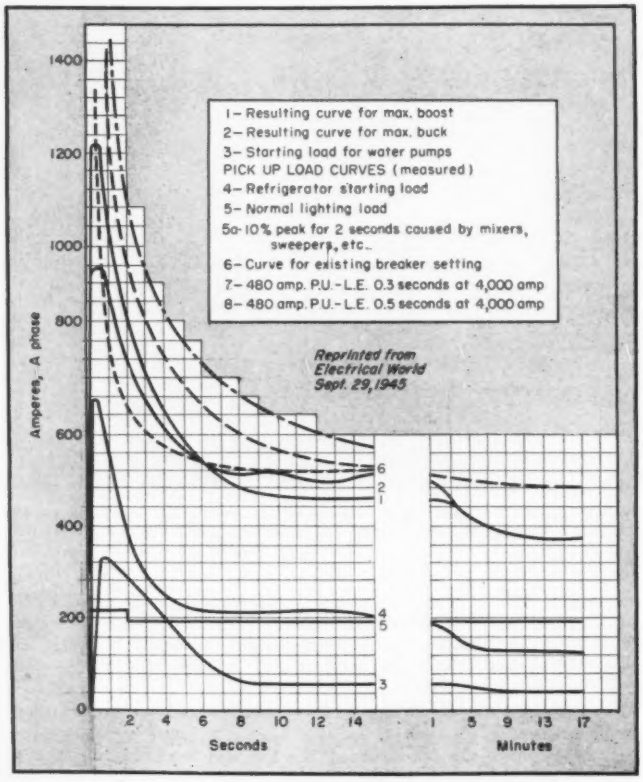


FIG 1—CALCULATED STARTING CURRENTS on 2.3-kv, 300-amp, delta circuit after 29-min outage; average normal load, 1,260 amp per phase. Inrush current re-opened breaker when service resumption attempted. Less inverse curves are for low-energy relays that would have let breaker remain closed during inrush

When Diversity Disappears . . . If a distribution circuit is de-energized for a prolonged period, tasks normally done by the delivered energy accumulate. Much if not all of the diversity normally present disappears for each of the automatically-controlled devices. Many of the manually-controlled devices are switched "on" awaiting reenergizing of the circuit. Thus an abnormal load is created that has: (1) A duration that depends on the rapidity with which accumulated tasks are done and (2) a magnitude that depends on the amount of diversity normally effective.

Besides this abnormal load, two other factors cause abnormal high short-time loads. One is the inrush current to magnetic circuits and the cold filaments of incandescent lamps. This may be 10 or more times normal —but lasts only a few cycles, thus it can usually be neglected. More important is the starting current of the motor-operated appliances that become connected to the circuit during a prolonged outage.

Relatively little data has been published on the shape of the re-energizing current-time curve. A representative one is shown in Fig 1. But this curve is not typical of all situations for, as will be shown, both maximum magnitude and fatness of the curve appear to be functions of circuit design and character of load.

Initial inrush current has several components: (1) Current to magnetize

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Based on a paper first presented before the Southeastern Electric Exchange, Transmission and Distribution Committee, Atlanta, Ga. and subsequently given before the Edison Electric Institute Transmission and Distribution Committee at New York.

havior of Feeders After Extended Outage

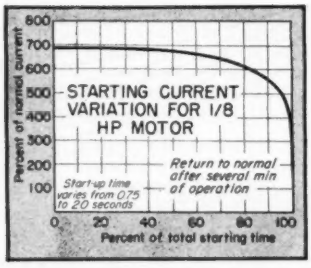


FIG 2—CURRENT VARIATION during starting cycle of a typical ⅛-hp refrigerator motor at 100% rated voltage. For this motor, the start-up time varies between 0.75 and 2.0 sec

iron in meters, transformers and motors, (2) current to raise the temperature of lamp filaments and (3) current to supply other loads. If the circuit is closed on the crest of the voltage wave, the value of inrush current will likely be governed as much by line and supply impedance as by load impedance. In a few cycles magnetizing and lamp filament inrush currents decrease to stable values. The remaining current consists of motor starting current, and other load current.

Shape of a motor's starting time-current depends on the kind of motor as well as the torque and inertia characteristics of the load. Fig 2 shows the variation of starting current during the starting cycle of a ⅛-hp refrigeration motor. Table I gives approximate characteristics of single-phase motors representative of those used on conventional appliances.

Because some loads have high inertia and sustained high torque requirements during acceleration, their motors start slowly. Other motors with less severe starting duty accelerate rapidly and reach full-load speed and normal current in a few seconds. The current in the distribution line is the sum of the individual starting currents at any instant. But it is accurate enough for present purposes to assume motor starting current of 4 to 6 times full load motor current and its duration 5 to 15 sec.

TABLE I—Characteristics of Single-phase Motors Used on Appliances

Application	Nominal Hp	Starting Amp	Starting P. F.	Running Amp	Running P. F.	Moto Type
DOMESTIC APPLIANCE MOTORS, 115 V						
Domestic refrig. up to 8 cu ft.... 2 Unit refrig. and freezer	1/8	13	0.90	2.2	0.59	Split phase
Domestic refrig. about 8 cu ft... Home freezer 4 cu ft	1/6	19	0.90	2.5	0.62	Split phase
Home freezer from 4 to 12 cu ft	1/4	21	0.90	4.2	0.58	Split phase
Oil burner (burner mechanism)..	1/8	15	0.80	2.3	0.65	Split phase
Warm air furnace blower.....	1/6 to 3/4	20 to 60	0.80 0.80	2.95 to 7.5	0.65 to 0.75	Split phase thru 1/3-hp capacitor 1/2 to 3/4-hp
Room cooler..... Compressor fan.....	1/2 1/15	35 15	0.80 0.80	8.1 1.45	0.70 0.60	Capacitor Split phase
Room cooler (large size)..... Compressor fan.....	3/4 1/8	55 20	0.80 0.80	9.7 2.7	0.90 0.65	Capacitor Split phase
Washer, tumbler dryer.....	1/4	38	0.80	4.8	0.62	Split phase KH
PROBABLE MOTORS FOR DOMESTIC AIR CONDITIONING, SINGLE-PHASE, 230 V						
5 or 6 room house.....	3	70	0.80 to 0.86	13.2	0.95	Capacitor
8 room house.....	5 or 5	125 95	0.80 to 0.86 0.35	23 23	0.95 0.93	Capacitor Repulsion-Induction

Courtesy of C. Dorsa and H. Campbell, General Electric Co.

After some seconds motors will reach running speed and motor current will decay to a running value. The abnormal current remaining is due to the accumulation of tasks or loss of diversity.

How much diversity is present and how fast it is lost when the circuit is de-energized cannot be known precisely. Since refrigerators run about 5 out of every 20 min one can speculate that their diversity is lost in an outage lasting 20 min or so. Similar reasoning can be applied to water heaters, ovens, water pumps, and other automatically-controlled appliances.

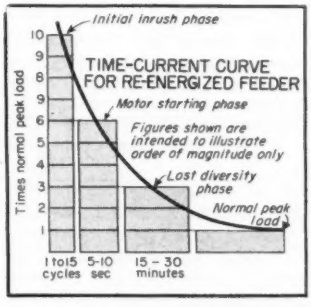


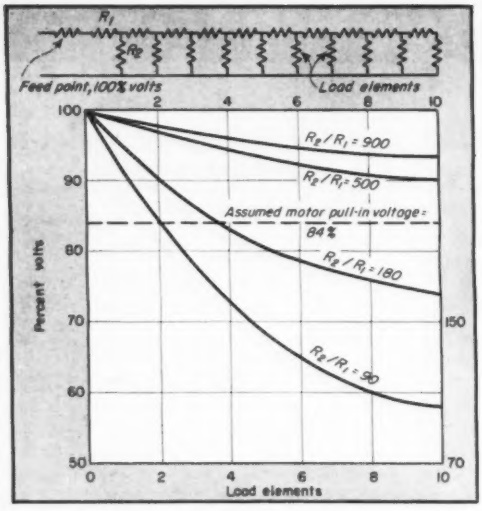
FIG 3—TIME-CURRENT CURVE of distribution circuit re-energized after prolonged outage has four phases: Brief, high-current inrush to magnetic circuits and cold lamp filaments; motor starting period; performance tasks accumulated during outage and normal peak

Loss of diversity may also occur on manually controlled appliances such as incandescent lamps, range top units, fans, window coolers and much air conditioning equipment. Also at certain times there may be a very high percentage of manually-controlled equipment turned on.

Conversely, supervisory control of load—for example water heaters—can be used to reduce the effects of loss of diversity. Large manually started loads with no voltage release equipment, such as central air conditioning systems, may also have a negative effect.

Over-all, the diversity applicable to the composite residential circuit load probably lies between 2 and 4. With a high saturation of automatic appliances, particularly refrigerators, it might approach 4. A circuit having more manually controlled equipment would likely produce a lower figure —possibly approaching 2. In extreme cases, such as a secondary network having large amounts of central air conditioning the figure may be less than 1.

A rough idea of the shape of the



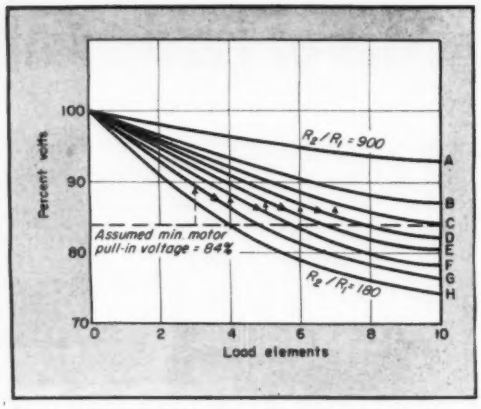


FIG 4—VOLTAGE DROP along hypothetical feeder having various ratios of shunt to series elements

FIG 5—SEQUENTIAL RECOVERY of voltage along feeder (Fig 4) when re-energized following a prolonged outage

re-energizing current curve can be shown as in Fig 3 which illustrates only the order of magnitude.

Re-energizing Load . . . To appreciate the magnitude of re-energizing current during the motor starting phase, consider a 13.2-kv circuit having a peak load of 5,000 kva serving predominately residential urban distribution loads. Various proportions of motor and other lighting and heating loads on such a circuit might be as given in Table II.

No allowance is made in Table II for loss of diversity in thermostatically-controlled devices or other accumulation of load due to the outage. An offsetting factor is the fact that voltage drops are excessive. This tends to reduce the theoretical currents that would prevail if no voltage drop occurred.

Thus, when it is considered that many overload devices are set to operate at 2 to 4 times load, re-energizing difficulties can occur.

Theoretical Aspects . . . A uniformly loaded radial circuit can be approximated as in Fig 4. This circuit consists of 10 equal loads spaced equally along the line. With 6% normal drop from feed point to last load, the ratio of shunt to series element impedance (R_2/R_1) is 900 and (top curve of Fig 4) shows the profile of voltage along this line. If under the re-energizing condition, load is 5 times normal the R_1 elements have 1/5 their normal impedance and R_2/R_1 becomes 180 instead of 900 for the normal condition. The voltage drop from the feed point to the last load is 26% instead of 6% for normal condition and the line's voltage profile is shown by curve having an R_2/R_1 ratio of 180.

These curves suggest two important things:

1. The rate of voltage drop is greatest at the supply end, assuming uniform conductor size and spacing of loads.

2. If the voltage at the first load element is not maintained at or above the voltage required for motors to pull in, the load will remain indefinitely at about motor starting level.

Now assume the minimum primary voltage (Fig 4) needed to cause motors to "pull in" is 84%. Voltage at motor terminals will be appreciably lower. Immediately after re-energizing, motors of load elements 1, 2 and 3 will rotate and begin to "pull in." All others will not have enough voltage to "pull in" or possibly to start rolling. As motors of elements (1), (2) and (3) "pull in," their starting current falls off, the voltage rises on element (4) motors and they "pull in." Thus the "pull in" of motors and consequent reduction of starting current can be visualized as a wave which starts at the supply end of the line and progresses to the outer end. The velocity of this wave (of sequential "pull in") determines, in part, the "fatness" of the time-current curve. Obviously this "fatness" will vary with the design of circuits. The presence of regulators for instance may either slow up the velocity of the wave or accelerate

TABLE II—Estimate of Re-Energizing Current During Motor Starting On 13.2-kv Residential Circuit

	Connected Automatically Controlled Motor Load in % of Normal Peak Load of Circuit					
	25	50	75	100	200	300
Full-speed connected motor load, amp	55	110	165	219	438	657
Normal peak load, amp						
Probable motor load, diversity = 3	18	36	55	73	146	219
Other load	201	183	164	146	73	.....
Total Circuit peak load	219	219	219	219	219	219
Current during motor starting phase, amp (Based on 100% voltage)						
Motor starting load @ 500%	275	550	825	1,095	2,190	3,285
Other load	201	183	164	146	73	.....
Total current	476	733	989	1,231	2,263	3,285
Percent of normal circuit peak, amp	217	335	450	568	1,036	1,500

it. A long 13-kv rural circuit may require a longer time to accelerate all its motors than a comparatively short urban circuit; or a long express feeder portion may have so much drop that "pull in" of any motors is prevented.

To test the validity of this reasoning, the curve of Fig 4 with $R_2/R_1 = 180$ was assumed to represent the voltage profile of a circuit upon re-energizing after a prolonged outage. Curve H Fig 5 is exactly the same and it is assumed only those load elements receiving 84% or more voltage with pull in. Thus for the H curve Fig 5 the motors of load elements 1, 2 and 3 will pull in while those of elements 4, 5, 6, 7, 8, 9, and 10 will not. As the motors of elements 1, 2 and 3 pull in, their power requirements fall off and voltage rises until at Curve G we have loads in elements 1, 2 and 3 at their normal level while loads in elements 4, 5, 6, 7, 8, 9, and 10 are at five times normal. Now when Curve G condition is reached the motors in element 4 have enough voltage to pull in. This process is repeated to obtain Curves F, E, D, C, B and finally, with all loads back to normal operation, Curve A is obtained.

If the wave of sequential motor "pull in" fails to progress along the line it means that no matter what relay setting is used, that part of the circuit will not start. Moreover, if energy is not removed in a short time damage to equipment will occur.

Predicting Performance . . . A procedure for predicting start-up performance of a circuit after a prolonged outage might be as follows:

1. Determine whether the circuit will start up. Do this by breaking the circuit into load groups (say 10) and reducing the circuit to a single impedance to determine total current inflow that should approximate normal full load on the circuit.

2. Determine by estimate or measurement the ratio of current during motor starting phase (after prolonged outage) to normal peak load current.

3. Determine voltage drops between load groups under normal conditions. Multiply these drops by the ratio obtained in (2) to obtain abnormal drops prevailing during motor starting period.

4. Use abnormal drops obtained in (3) to determine if motors in first load group obtain enough voltage to "pull in." If they do, investigate second group on the basis that first group takes normal full load current; all other groups abnormal current—and so on.

5. If the circuit will start the problem is to pick settings for protective devices that will carry initial inrush without operation but operate promptly on fault. Next, multiply ratio found in (2) by normal full load current. This gives the current during motor starting that the protective device must handle without operation if the circuit is to remain intact during start-up. Thus if the ratio (2) is 5, fuses should be applied in such a manner that the continuous current capacity of the fuse is about 5 or more times the normal load through the fuse.

6. If the circuit will not start part of the circuit must be de-energized promptly. The amount of circuit de-energized must be big enough to reduce the drops to the first load group to permit the first load group motors to "pull in"—and similarly for other load groups.

If The Circuit Starts . . . Since the magnitude and duration of start-up current is uncertain and it is desirable to avoid trouble as long as possible, the use of the highest practicable feeder relay setting seems indicated. In some cases the substation transformer or transmission line may limit settings. More frequently the length of the primary circuit may limit relay settings if the relay protects the entire circuit. If settings are limited, fuses or automatic reclosers can be used to protect more distant parts of the circuit, permitting the feeder relay setting to be increased.

Use of fuses for circuit sectionalizing purposes, as for example in the selective fuse breaker coordination scheme, generally assumes that start-up current is moderately larger than full load. However, magnitudes of start-up current brought about by today's increasing motor loads may restrict the length of line a fuse can protect and not melt during start-up. For example, consider a fuse link which can carry 100 amp continuously. On circuits having moderate motor load and moderate start-up current, this fuse might be considered to have a short circuit current range of 4.66 times—from 1,500 amp (0.2 sec) to 340 amp (4 sec). If normal load on the fuse was 70 amp and the circuit supplied a high percentage of motor load there might be 350 amp or so during start-up. If things did not get moving to reduce the current in 4 sec the fuse would melt. A better practice might be to recognize the possibility of a starting load of 500 amp, use a bigger fuse, and restrict its fault current melting time range to about 0.2 sec to 1.0 sec. The bigger fuse would melt on fault but would not melt on start up currents of 5 times rating. Such a practice will result in more sectionalizing fuses being used but will provide more prompt fuse blowing during fault.

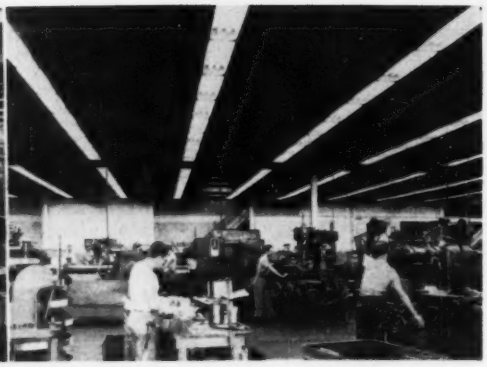
Setting of relays and reclosers which will not lock open under start-up current conditions follows a similar philosophy to that for fuses.

If Circuit Won't Start . . . When a circuit will not start either wholly or in part, the "balky" must be de-energized promptly to avoid damage to utilization equipment. Otherwise motors will be running below pull-in speed, draw high current and heat rapidly.

This problem can be both serious and embarrassing to distributors of electricity. It offers a challenge to the manufacturers. The job can be done automatically *if suitable switches* are installed on appropriate branches and arranged to trip some time after loss of voltage. Then the switch would have to be arranged to close some time after voltage is restored. Each switch would have a different closing interval so that the starting loads of the several switched circuits would not be superimposed but would occur sequentially.

The need for low cost and simplicity in such a device would probably dictate use of the same tripping interval on each switch—possibly between 3 and 6 seconds. This would allow the switch to ride through the average trip-out and immediate reclosure without operating. The closing interval would have to be variable, perhaps a range of 1 to 15 min would be adequate for all situations or it might depend upon magnitude of voltage. So far as the writer knows such switches are not available!

SLIMLINE FLUORESCENT lamps providing more than 80 ft-c of light at the Greist Mfg Co, Bridgeport, Conn., are combined with light colored surroundings to make seeing easier



BAY LENGTH ROWS of two-lamp (85-w) fixtures on 10-ft centers, 17-ft height, provide 60-ft-c in machine shop of White Motor Co, Cleveland, where large metal parts are machined

Good Lighting and Color Stimulate High

Combination of color and brightness finishing of industrial interiors with adequate planned lighting designed to have good quality for easy seeing produces proved dividends in plant output, conservation of employee's eyesight and health

C. E. EGELER, Illuminating Engineer
General Electric Co, Nela Park, Cleveland, Ohio

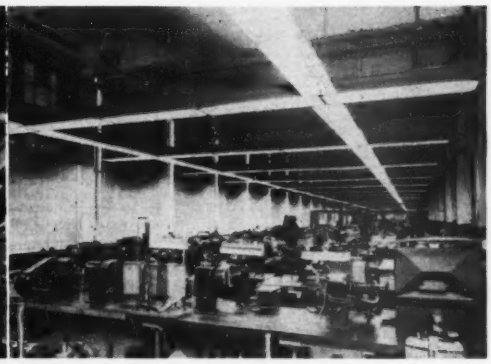
Color and good lighting are partners in producing seeing conditions which stimulate high industrial production. Lighting has grown from the specification of foot-candles to the addition of quality requirements. These involve not only the use of source sizes and locations to reduce direct and reflected glare, but also specifications for the brightness and color of the surroundings of the task, both the immediate background and more distant walls—in fact, all surfaces within the normal line of vision. This is necessary to provide comfortable seeing conditions in many high production tasks involving continued difficult seeing even with an adequate amount of illumination at the work. The disturbing and detrimental contrast brightness patterns in the usual and casual lines of vision even may be accentuated with the production levels of today's modern industrial illumination, if care is not taken to avoid them. The undesirable brightness contrast aspects could be taken care of simply by the use of enough white or grey paint, but color contributes some additional features of marked value. Today color conditioning of industrial interiors together with good lighting is an accepted feature of plant design and operation. It is not so much a factor of decoration, but rather an element in the production process.

From the standpoint of their relation to lighting, the amount of light reflected by the wall, machine and other surroundings is the most important characteristic. This, and the illumination on them, determines their brightness. For walls and columns in the line of vision, this brightness becomes a factor influencing the seeing process, and the amount of light reflected also is directly related to the efficiency of the lighting system in furnishing illumination values at the work task.

Easier Seeing . . . A good lighting system should provide an adequate amount of light for the seeing tasks being performed, minimum of direct and reflected glare, and, for comfortable seeing, background brightnesses comparable to those of the task and its immediate surroundings. Independently of their color, seeing is easiest when these background surroundings have the same brightness as the task. Practical considerations usually may make this difficult to obtain, and extensive research has shown that if the background brightnesses are only one-third of those for the tasks, almost as good seeing conditions will prevail. However, under the most adverse conditions, these brightnesses should not be less than one-fifth to one-tenth of those for the task.

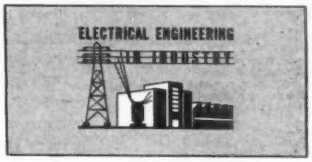
Their color produces features that may stimulate or soothe; it is well known that the red and orange hues particularly have a stimulating effect and their use is indicated in areas

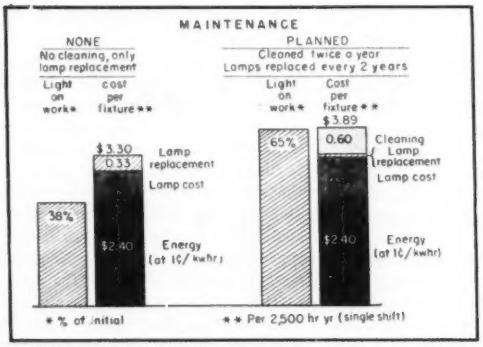
HIGH BAY 400-w twin mercury units alternated with 1,000-w filament units in G. E. Turbine Plant at Schenectady give 50 ft-c. Spaced 13x13 ft, units are 38 ft high and crane serviced



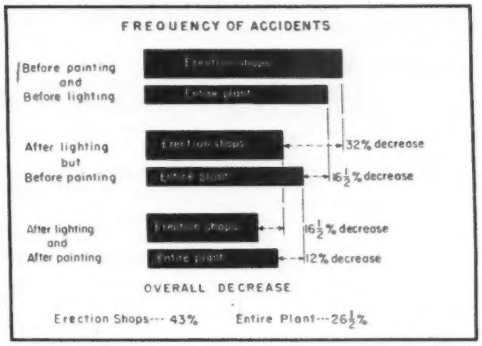
FLUORESCENT GRID system provides 80 ft-c in this fine assembly shop. Two-lamp (40-w) reflectors are mounted in rows spaced on 10-ft by 13-ft centers. Mounting height is 10 ft

Industrial Production





PLANNED MAINTENANCE brought about this comparison: A large increase in useful light on working surfaces compared with a small increase in maintenance cost per fixture



ACCIDENT DATA for Erection Shops of Allis-Chalmers Mfg Co showing percentage decrease in accidents after relighting and repainting. For some companies, accidents went down 75%

where the air temperatures tend to be low. On the other hand, the blues and greens produce soothing and restful reactions and they are widely employed in color conditioning. From the seeing standpoint, of particular interest is that the lighter hues of blue, green, and grey reflect 50% or more of the light. Thus, they can have the relatively high brightnesses, when adequately lighted, desirable for comfortable seeing conditions.

When adequate illumination of good quality is provided, in addition to suitable machinery, skilled workers' production invariably improves over what would be obtained with poor illumination. One company reported that a 25% increase in punch press production was obtained when special local or general lighting was installed. A textile mill increased production 9% and reduced mending cost 33%. A machine tool manufacturer reported a production increase of 15% in the first department lighted as a part of a relighting and refinishing program. Since the added cost of good lighting may be only 2% of the payroll, the return on the added investment can be several hundred percent per year.

The amount of light provided at the work areas should be determined by analysis of the seeing tasks. General recommendations for a variety of tasks are given in the table. The detail to be seen—the contrast in the work—whether the seeing is continual or intermittent—are pertinent factors affecting selection of the foot-candle level.

Color Combination . . . Although there is a wide choice of the many hues and their variations which could be employed, the blue-green, grey and buff tones have predominated in industrial color conditioning programs, with

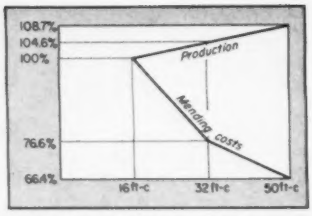
Recommended Levels of Illumination

	Minimum foot-candles in service (On task or 30 in. above floor
Most difficult seeing tasks..... Finest precision work, involving: Finest detail, Poor contrasts, Long periods of time such as extra-fine assembly, precision grading, extra-fine finishing	100 or more
Very difficult seeing tasks..... Precision work, involving: Fine detail, Fair contrasts, Long periods of time such as fine assembly, high-speed work, fine finishing	100
Difficult and critical seeing tasks.... Prolonged work, involving: Fine detail, Moderate contrasts, Long periods of time such as ordinary bench work an assembly, machine shop work, finishing of medium-to-fine parts, office work	50
Ordinary seeing tasks..... Involving: Moderately fine detail, Normal contrasts, Intermittent periods of time such as automatic machine operation, rough grading, garage work areas, switchboards, continuous processes, conference and file rooms	30
Casual seeing tasks..... such as stairways, reception rooms, washrooms and other service areas, active storage	10
Rough seeing tasks..... such as hallways, corridors, passageways, inactive storage	5

much more limited use of white for the wall finishes. The bluish greens are popular for the warm areas of a plant, such as the kettle room of a brewery, and light and brownish buffs for cooler areas, such as refrigerated or air conditioned spaces. A windowless building uses three tones of grey on the side walls, blue on one end wall and yellow on the other end wall to compensate for the lack of window outlooks. Another plant has machines finished in light grey, the walls and columns in light green, with a dark green stripe separating a grey dado; the ceiling is white as is standard regardless of colors used on the lower surfaces.

Some Typical Colors and Their Reflection Factors

Surface	Color	Approximate Reflection Factor, Percent
Ceiling	White	75-80
Upper walls	Light green Light Buff	50-55
Lower walls and machines	Dark green Dark buff	25-35
Task background	Medium green Medium buff	35
Floor		15



PRODUCTION DATA for Uxbridge Worsted Co showing how production was increased and mending costs were reduced when lighting intensities were increased from 16 ft-c to 50 ft-c

In its repainting, General Electric uses two principle color combinations. Of these the first choice is usually a blue-green to provide cheerful and colorful backgrounds. The other is the light buff, sometimes with a slightly brownish tint. The hues are graded downward from the white ceiling so that the brightness of the surfaces also step down, the light source itself having highest brightness. The best practice is to use lighting units which emit some light upward, thereby illuminating the white ceiling sufficiently so that a contrast between the brightness of the lighting unit and the ceiling is kept low.

Machine Finishes . . . The avoidance of black or very dark grey so commonly used on shop machines is of the same order of importance as the use of the lighter colors for the walls and other surfaces in the line of vision. This is because these machine surfaces are adjacent to the task, therefore near the line of work vision, and thus have an important bearing on the brightness comfort already emphasized as being a principle element in easy seeing. One study made to determine the choice of and production effects of machine tool finishes covered tests on a punch press and shear. Time studies included seven colors or combinations, yellow, light buff, medium grey, light grey, aluminum, light green, and dark green. The reflection factors varied from approximately 25 for the yellow, to 50 for the light grey under filament lamp illumination. Considering the practical aspects of keeping the machine surfaces relatively clean for the iron and steel working operations, light grey was adopted as the final finish, with light buff around the working area. The operators were so convinced of the benefits that they kept the light-hued surfaces clean on their own initiative.

Color of Light Sources . . . With the advent of the fluorescent lamp, there has been much interest and a variety of opinions as to which color of light should be used for industrial operations. While so-called white lamps for which the color temperature is about 3,500 K have been widely employed, with some interest in the daylight lamps particularly for metal working operations, recent experience has shown that the color of light emitted by the so-called standard cool white lamps finds the widest application. With a color somewhere between daylight and the older white lamps, the appearance of most industrial materials is excellent, considering the wide range encountered. Where color discrimination is an important part of the seeing task, then the de luxe cool white fluorescent lamp, gives fine color balance over the entire spectrum.

The specific hues employed in the color conditioning should accord with the color of light emitted by the lamps used in the area in question. This is because the color appearance of a painted surface usually varies considerably with the color composition of the light by which it is illuminated. For example, a particular color which looks pleasing under filament lamp or cool white fluorescent lighting, may appear entirely unacceptable under mercury lamp illumination. The use in a demonstration test of color chips or other finish samples supplied by a paint manufacturer, with the light source to be used, is the procedure which can be employed to the best advantage in the selection of the specific paints to be used.

More Efficient Lighting . . . Light ceiling, wall, and other surface finishes materially improves the amount of light received at the task. For example, if a ceiling reflecting 75% of the light and side walls 50% is employed instead of a ceiling reflecting only 25% and walls 10%, then 12% more foot-candles will be obtained in a typical medium sized area and even more near the walls where the lighting is usually the poorest. In office areas the increase may be much

(*Continued on page 153*)

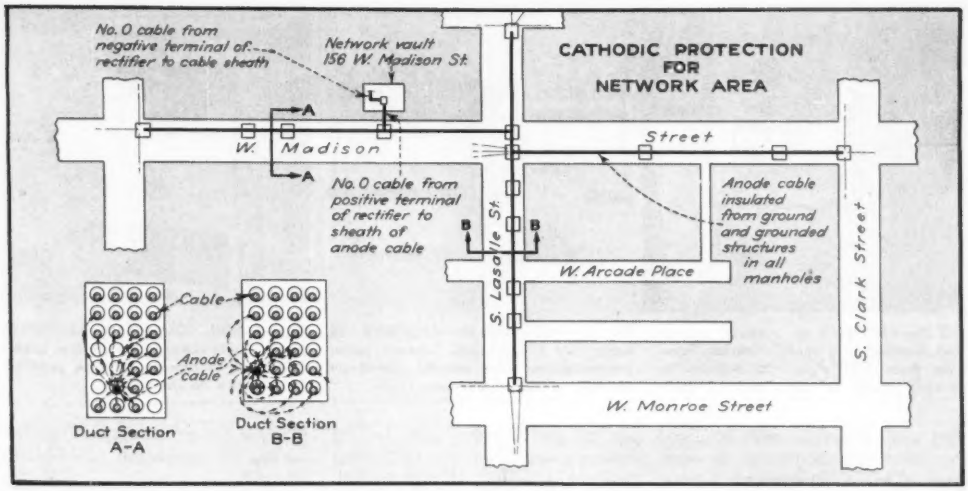

No. 0 cable from negative terminal of rectifier to cable sheath
Network vault 156 W. Madison St.
CATHODIC PROTECTION FOR NETWORK AREA
W. Madison Street
No. 0 cable from positive terminal of rectifier to sheath of anode cable
Anode cable insulated from ground and grounded structures in all manholes
S. LaSalle St.
S. Clark Street
W. Arcade Place
W. Monroe Street
Cable
Anode cable
Duct Section A-A
Duct Section B-B

FIG 1—CATHODIC PROTECTION has been provided for certain Chicago network areas by installing old cables—indicated as anode cables—in ducts to supply current path from rectifiers through the earth to the cable sheaths

Cathodic Protection Measures Stop Cable Sheath Corrosion Failures

Jacketed cables; rectifiers connected through old cables to force current flow to cable sheaths; tieing of cable sheaths, telephone cable and multigrounded neutrals to water pipes all contribute to solution of problem

W. T. ROSE, Engineer
Commonwealth Edison Co, Chicago, Ill.

Between 1940 and 1948 the underground system in the network area of Chicago averaged a little over three corrosion failures per year. Studies of conditions under which those failures were occurring resulted in some new designs for cathodic protection. Since this protection was provided in 1948 there have been no cable failures in the protected areas.

Cable sheath potentials in the company's network area have been watched very closely for the last ten years. In 1947 it was decided that the sheath potential had been raised to a dangerous point and that corrective measures should be taken. Over 265 duct surveys were made in the network area and it was found that 23% of the cable sheaths were anodic and 53% varied from positive to negative depending on the location along the conduit run. Before the network was started, sheath potentials were about one volt negative to the rails and about one-half volt negative with reference to the earth.

Two methods of protecting cable sheaths in the network area are now being used:

1. Jacketed Cables . . . Cables with a jacket over the lead sheath are being used for new installations and for replacements on the 9- and 12-kv lines. This is standard practice in the loop area. In the network area north and west of the river, jacketed cables are used only at specified locations, as indicated by test data.

2. Cathodic Protection . . . To protect non-jacketed cables in the anodic areas, a rectifier is used to force current through the earth from a used or "anode" cable to the cable sheaths.

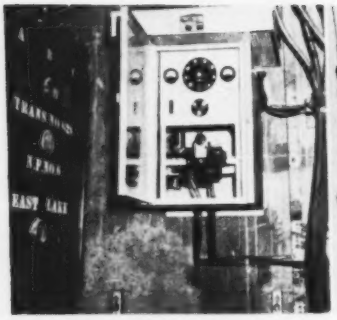


FIG 2—RECTIFIER for cathodic protection installed in a vault. This one operates from 120 v ac. It delivers dc through earth to old "anode" cable

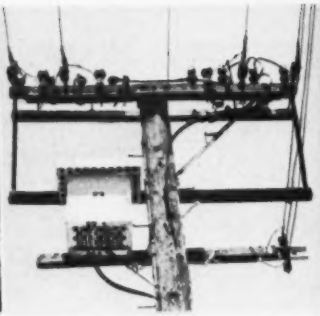


FIG 3—AIR COOLED RECTIFIER on cable pole is connected between power and telephone cable sheaths and street car rails to reduce corrosion

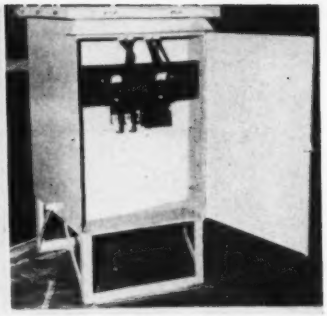


FIG 4—OIL IMMERSED RECTIFIERS have been installed in transformer vaults. There are at present 25 such rectifiers in operation on the system

This used, or anode, cable is placed in a lower duct and it raises the earth potential in the vicinity of the conduit run, thereby providing cathodic protection. This makes a very flexible method of applying protection because the used or anode cable can be extended to cover new areas where protection is needed. It will have to be replaced when it becomes seriously corroded. To date four rectifiers have been installed providing protection for more than 36,000 ft of non-jacketed 9- and 12-kv cables.

The design for one of the cathodic protection systems used in the network area is shown in Fig 1. Sections A-A and B-B show the actual position of the anode cable in the duct run. Arrows show the flow of current which provides cathodic protection for the other cables. This anode cable is approximately 1,400 ft long.

Fig 2 shows a cathodic protection rectifier in a network vault. This rectifier operates on 120 v ac and has 18 taps for changing the secondary dc voltage. At the present, this rectifier is delivering 5 amp to the anode.

Multi-Grounded Neutral . . . The second change in electrolysis conditions involves the installation of multi-grounded or common neutrals on the 4-kv overhead distribution system. With this system, cable sheaths are grounded through the neutral to the water pipe at each service. To date there has been no trouble from a corrosion standpoint with the exception of a few locations. At one location the difficulty was corrected by re-installing separate neutrals near the cable pole. In other words, cable sheaths are still tied to water pipes but the nearest connection is one block away from the cable run. Most of the difficulties in connection with the common neutral have been the increase in noise level on the telephone lines. Most of these conditions were corrected by providing shielding connections between the neutral and the telephone cable sheath. To date there have been 74 shielding ties to the telephone system.

Stray Currents . . . The third and most important change involves the replacing of street cars with buses. When all street car lines in the city were operating, a system of cable sheath drains was installed to connect the various dc substations. These drains were arranged to take advantage of the voltage drop along street car rails to provide cathodic protection for cable sheaths. Also, the drains were heavy enough to provide a metallic path to the negative bus, so that the drainage current would not leak off through the earth and cause corrosion. Now there are various combinations of conditions in these areas:

1. Areas where the rails are still connected but not loaded.
2. Rails in place but disconnected from the substation.
3. Areas where rails have been removed.

At most of these areas corrective measures must be of a temporary or very flexible nature, because conditions will change if more street car lines are removed. To provide protection in these areas, various methods were found to be effective. At some locations rectifiers were used to force drain the dc from cable sheaths. This drainage current is forced to the street car rail, the negative bus, or to a buried electrode.

A typical air-cooled rectifier installed on a cable pole is shown in Fig 3. This rectifier is connected between power and telephone cable sheaths and the street car rails. It is rated at 80 amp and 8 v. At the present time it is operating at 20 amp and 3.2 v.

An oil-immersed rectifier before installation is shown in Fig 4. This type of rectifier has been installed in transformer vaults. There are now a total of 25 rectifiers in operation on the system.

At other locations, protection is maintained by increasing the capacity of drainage connections to the negative bus in the dc substations. At some locations, it was found that the potential between cable sheaths and unloaded rails varied from positive to negative due to the street car load cycle. During certain hours of the day sheaths had cathodic protection, and during the remaining hours the sheaths were anodic. To improve conditions at these locations, cable sheaths were connected to the rail through a uni-directional type valve. These valves permit current to flow to the rails when sheaths are anodic but prevent the current from reversing when sheaths are cathodic.

Lead Grounds . . . Another change in design involving generating stations, is the use of lead ground rods instead of copper grounds. This will eliminate or reduce the galvanic potentials between station ground bus and other buried metals, especially cable sheaths.

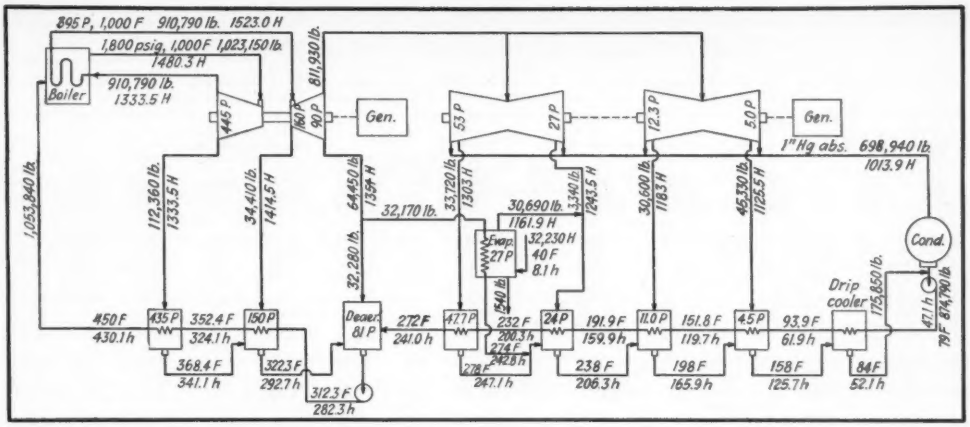


FIG 1—HEAT BALANCE DIAGRAM for full load on 160 Mw units at 1,800 psig 1,000/1,000 F and 1 in. Hg abs. exhaust pressure; seven extractions. "P" indicates steam pressure in psia; "H" is in Btu/lb of water; steam in lb/hr is also given

Cost Analysis for 160-Mw Units Favors 1,800 Psi, 1,000 F Reheat

Study for New York's new station converged to 32 combinations of pressure, temperature, boiler and heater arrangements. Theoretical net heat rate is 9,335 Btu per kwhr for selected conditions

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To provide for the rapidly expanding load, the company is initiating the development of a new generating station on the East River in the Borough of Queens with an ultimate capacity of about 1,000 Mw. A cost study was made to determine the economical size and type of boiler, turbo-generator and related equipment for this station. Factors considered include: (1) Economical capacity of the unit; (2) single boiler versus two boilers per turbine; (3) unit type design versus a common steam header system and (4) reheat versus non-reheat units.

Comparison favored 160-Mw cross-compound units served by single boilers operating at 1,800 psi and 1,000 F with reheat to 1,000 F. Seven feed water heaters will be used and all but the deaerating heater will be closed. The cycle (Fig 1) has a theoretical net heat rate of 9,335 Btu per kwhr excluding certain losses. When these station losses including blow-down, steam for atomizing oil burners, general building service are considered the actual net station heat rate should approximate 9,700 Btu per kwhr.

The following factors were studied:

1. Turbogenerator . . . Three sizes of unit were studied, namely units of 80, 110-and 160-Mw maximum rated capability. Units larger than 160 Mw were not considered because the system already had some units of this capacity and units of materially increased rating would be burdened with a higher system reserve.

2. Boilers per Unit . . . In the case of the 160-Mw units operating on the unit type system with no reheat, arrangements were estimated for both single boiler and two boiler per turbine combinations. The operating complications using reheat cycles on multiple boilers per turbine or on steam header systems are such as to make such arrangements impractical and they were not estimated.

3. Tandem Versus Cross-Compound Units . . . The 80-Mw and 110-Mw units studied were all tandem compound whereas proposals were obtained for both tandem and cross-compound units in the 160-Mw capacity.

4. Non-reheat Cycles . . . For non-reheat, units operating at 1,050 F, 1,450 psi were considered the upper limit of pressure as this cycle produces about 12.5% moisture at the exhaust of the turbine. This cycle was com-

Adapted from recent ASME paper 50A87 entitled, "Basic Study for a Generating Station."

TABLE I—Summary of Cost Differentials for 32 Cycle Combinations

Assumptions: Fuel Cost, 40¢ per million Btu. Operation, 6,625 hr per year at full load (weighted). Capitalization factor, 6.25. All cases 1 in. Hg back pressure. XC = cross compound; TC = tandem compound.

Case	Mw	Type	Psi	Temp, deg F	Boilers per unit No.	Features	Heat Rate Btu/kwhr	Heat Rate Diff., $/kw	* Costs of Installed Equipment, $/kw	*Estimated Operating Labor Costs, $/kw	Estimated Maintenance Costs, $/kw	*Estimated Electrical Demand & Capitalized Energy Charges: Demand Charges, $/kw	Energy Charges $/kw	Net Reserve Capacity Costs $/kw	* Compilation of Costs $/kw	Cost Differentials $/kw
1	160	XC	1,800	1,050/1,000	1		9,283	1.09	161.63	3.65	5.47	9.87	8.94	14.53	205.18	1.50
2	160	XC	2,000	1,060/1,000	1		9,222	0.09	164.19	3.65	5.42	9.87	8.94	14.53	206.68	3.00
3	160	TC	1,800	1,050/1,000	1		9,278	1.01	165.96	3.65	5.36	9.87	8.94	14.53	209.32	5.64
4	160	TC	2,000	1,050/1,000	1		9,217	0	168.90	3.65	5.32	9.87	8.94	14.53	211.21	7.53
5	160	XC	1,450	1,050	1		9,758	8.96	160.82	3.65	5.68	9.84	8.94	14.95	219.84	9.16
6	160	XC	1,250	950	1		10,108	14.76	158.43	3.65	5.92	9.84	8.94	15.32	216.86	13.18
7	160	TC	1,450	1,050	1		9,820	9.99	165.00	3.65	5.56	9.84	8.94	14.95	217.93	14.25
8	160	TC	1,250	950	1		10,205	16.36	161.73	3.65	5.81	9.84	8.94	15.32	221.65	17.97
9	160	XC	1,450	1,050	2		9,758	8.96	177.67	3.65	7.80	9.80	8.87	10.89	227.64	23.96
10	160	XC	1,250	950	2		10,108	14.76	174.56	3.65	8.11	9.80	8.87	11.08	230.83	27.15
11	160	TC	1,450	1,050	2		9,820	9.99	174.02	3.65	7.69	9.80	8.87	10.89	224.91	21.23
12	160	TC	1,250	950	2		10,205	16.36	170.74	3.65	8.02	9.80	8.87	11.08	228.52	24.84
13	160	XC	1,450	1,050	2		9,758	8.96	184.72	3.65	7.80	9.80	8.87	−0.88	223.72	20.04
14	160	XC	1,250	950	2	oversized,	10,108	14.76	179.41	3.65	8.07	9.80	8.87	−0.07	224.49	20.81
15	160	TC	1,450	1,050	2	on header	9,820	9.99	177.13	3.65	7.69	9.80	8.87	−0.08	217.05	13.37
16	160	TC	1,250	950	2		10,205	16.36	175.48	3.65	8.02	9.80	8.87	−0.07	222.11	18.43
17	110	TC	1,450	1,050	1		9,976	12.57	174.70	4.29	7.33	10.35	9.38	7.45	226.07	22.39
18	110	TC	1,250	950	1		10,386	19.36	168.34	4.29	7.66	10.35	9.38	7.59	226.97	23.29
19	80	TC	1,450	1,050	1		10,178	15.92	181.55	5.53	9.42	10.31	9.35	6.15	238.23	34.55
20	80	TC	1,250	950	1		10,598	22.87	176.74	5.53	9.86	10.31	9.35	6.15	240.81	37.13
21	160	XC	1,450	1,050	1		9,758	8.96	170.98	3.65	5.68	9.84	8.94	0.25	208.30	4.62
22	160	XC	1,250	950	1	oversized,	10,108	14.76	168.16	3.65	5.92	9.84	8.94	0.28	211.55	7.87
23	160	TC	1,450	1,050	1	on header	9,820	9.99	174.54	3.65	5.56	9.84	8.94	0.25	212.77	9.09
24	160	TC	1,250	950	1		10,205	16.36	171.69	3.65	5.81	9.84	8.94	0.28	216.57	12.89
25	160	XC	1,450	1,050	1	add'l. blr.	9,758	8.96	174.92	3.65	6.38	9.84	8.94	0.09	212.78	9.10
26	160	XC	1,450	1,050	2	on hdr.	9,758	8.96	186.22	3.65	8.32	9.80	8.87	0.09	225.91	22.23
27	160	XC	1,450	1,050/1,000	1		9,415	3.28	159.95	3.65	5.61	9.87	8.94	14.71	206.01	2.33
28	160	XC	1,450	1,050/1,000	1		9,476	4.29	158.11	3.65	5.63	9.87	8.94	14.71	205.20	1.52
29	160	XC	1,450	950/950	1		9,611	6.53	155.21	3.65	5.64	9.87	8.94	14.84	204.68	1.00
30	**160**	**XC**	**1,800**	**1,000/1,000**	**1**		**9,335**	**1.95**	**159.12**	**3.65**	**5.55**	**9.87**	**8.94**	**14.60**	**203.68**	**0**
31	160	XC	1,650	1,000/1,000	1		9,425	3.45	158.69	3.65	5.60	9.87	8.94	14.71	204.91	1.23
32	160	XC	2,200	1,000/1,000	1		9,138	−1.31	166.23	3.65	5.44	9.87	8.94	14.36	207.08	3.40

* Cost items common to all cases are omitted.

pared with the 1,250-psi, 950-F cycle for a number of boiler arrangements.

5. Common Header Versus Unit Type . . . In order to make cost comparisons between arrangements using a common steam header and the unit-type design, two variations of the steam header were studied. In one arrangement all boilers were made over-size, so that upon the outage of one boiler the remaining boilers would be paralleled on the header so as to operate all of the turbo generators with the remaining boilers operating at maximum rated capability. The alternate arrangement provides a spare boiler of the same size as the other units together with a header of the transfer type, so that segregated operation can continue even during the outage of a boiler. At the higher temperatures and pressures being considered, segregated operation of the units is preferable whenever this is possible.

6. Reheat versus Non-reheat . . . Sufficient cases were estimated on non-reheat units operating at throttle pressure from 1,250 psi to 1,450 psi and temperatures from 950 F to 1,050 F to enable comparison with reheat units ranging in pressure from 1,450 psi to 2,200 psi and in temperature from 950 to 1,050 F. Comparisons were made for fuel costs of 30¢ and also 40¢ per million Btu but only the latter are reported herein. In addition, for the reheat cycles the cost of fuel necessary over the life of the equipment to justify the installation of the higher pressures and temperatures are also shown.

7. Feedwater Heating . . . Installed cost and relative economy of five, six, seven and eight stages of feed water heating were considered with one of these stages always being a deaerator. Both open and closed type heaters below the deaerator were studied. In addition parallel trains of closed heaters above the deaerator were compared with arrangements having a single train of closed heaters with one additional heater in the train and with individual by-passes around each heater or a single by-pass around the entire group.

8. Feed Pumping . . . Arrangement employing a single boiler feed pump with all closed heaters above the deaerator operating at boiler pressure was compared to the combination of booster pumps ahead of the boiler feed pumps with the closed heaters in between these pumps so as to operate the heaters at relatively low pressure.

Basic Assumptions . . . In order to simplify the studies and reduce the number of cases to be studied to a practical figure, the following assumptions were made to determine items 1 to 6 above.

1. Feedwater temperature entering boiler was assumed to be 450 F.

2. Feedheating would be done in six stages with approximately equal increments of enthalpy.

3. Use of condensate for oil coolers, air ejector condensers and gas coolers would not be considered in the comparative studies because of their negligible effect on the differential heat rates.

4. From study of a recent unit, 1 in. Hg back pressure with 45-F circu-

TABLE II—Reserve Capacity Required Based on Forced Outage Rate of 2%

Group	Cases 1 to 8 Cases 27 to 32	Cases 21 to 24 Inclusive	Case 25	Cases 9 to 12 Inclusive	Cases 13 to 16 Inclusive	Cases 17 & 18	Cases 19 & 20
	6 Units 6 Boilers	6 Units 6 Oversized Blrs. on Common Hdr.	6 Units 7 Boilers on Common Hdr.	6 Units 12 Boilers	6 Units 12 Oversized Blrs. on Common Hdr.	9 Units 9 Boilers	12 Units 12 Boilers
1. Proposed Plant Capacity, Mw	960	960	960	960	960	990	960
2. Required System Reserve Capacity, Mw	554	502	501	529	500	520	500
3. Reserve Capacity Added to System Installation, Mw	109	57	56	84	55	75	55
4. Increase in Peak Demand Provided by Installation, Mw	851	903	904	876	905	915	905
5. Outage for Scheduled Overhaul							
(a) Turbines, 6 weeks/yr on 5 yr schedule, Mw-Mo.	265.8	265.8	265.8	265.8	265.8	274.2	265.8
(b) Boilers, 2 weeks/yr on yearly schedule, Mw-Mo.	354.5	0	0	354.5	0	365.5	354.5
(c) **Total,** Mw-Mo.	620.3	265.8	265.8	620.3	265.8	639.7	620.3
(d) Equivalent Annual Capacity, Mw	51.7	22.2	22.2	51.7	22.2	53.3	51.7
6. Equivalent Peak Demand Provided by Installation, Mw	799.3	880.8	881.8	824.5	882.8	861.7	853.3
7. Equivalent Plant Capacity Required for Equal Peak Demand & Service Reliability, Mw	1,043.4	962.0	961.0	1,018.5	960.0	1,011.1	989.5
8. Equivalent Annual Generation, 10^6 Kwhr	6,487	6,174	6,168	6,331	6,162	6,285	6,151

TABLE III—Comparison of Break-Even Fuel Cost for Reheat Cycles (All for One Boiler per unit and 1 in. Hg Vacuum)

Case	Mw	Type	Psi	Temp, deg F Init. Reheat	Net Station Heat Rate, Btu/kwhr	Eval. Costs Without Fuel	Break-even Fuel Cost-¢/10^6 Btu
29	160	XC	1,450	950/950	9,611	198.15	....
30	160	XC	1,800	1,000/1,000	9,335	201.72	31.2
31	160	XC	1,650	1,000/1,000	9,425	201.45	42.8
1	160	XC	1,800	1,050/1,000	9,283	204.09	43.7
28	160	XC	1,450	1,000/1,000	9,476	200.91	49.4
32	160	XC	2,200	1,050/1,000	9,138	208.38	52.2
2	160	XC	2,000	1,050/1,000	9,222	206.60	52.5
27	160	XC	1,450	1,050/1,000	9,415	202.73	56.4

TABLE IV—Computed Heat Rate with Various Feedwater Heating Arrangements

No. of Heaters	Pairs of Closed Heaters	Deaer-ator	Low Press. Heaters	Heat Rate at Various Temp. Diff. 3 deg F	6 deg F	10 deg F
5	2	1	2 Open	9,264	.....	.....
6	2	1	3 Open	9,237	.....	.....
7	2	1	4 Open	9,218	.....	.....
8	3	1	4 Open	9,203	.....	.....
5	2	1	2 Closed	.....	9,274	9,288
6	2	1	3 Closed	.....	9,250	9,267
7	2	1	4 Closed	.....	9,232	9,250
8	3	1	4 Closed	.....	9,218	9,237

lating water was assumed to be economical.

5. Motor driven auxiliaries would be used throughout and condensate and feed pumps would be provided with a standby pump.

6. Auxiliary power requirements were initially assumed at 7% of the gross generated output for computation of heat rates.

7. After discussion with the boiler and turbine manufacturers as to the availability, cost and present practicability of units for operation at 1,100 F and 1,200 F it was decided to limit the study to maximum steam temperature of 1,050 F.

Heat Rates . . . For evaluation of heat rate differences, fuel was assumed to cost 30¢ and also 40¢ per million Btu but only the latter figure will be reported herein. The load factor of the system would permit the initial annual loading of this unit as follows:

Full load .....5,000 hr
¾ load .....1,500 hr
½ load .....1,000 hr

To capitalize the fuel savings the first years fuel cost was multiplied by the factor 6.25.

Maintenance Costs . . . Study of the maintenance costs on high pressure boilers and turbine generators operated by this company, as well as other utilities, leads to the following assumptions:

1. A two boiler installation will require 50% more boiler plant maintenance including auxiliaries than will a one boiler installation for the same steam conditions and total capacity.

2. Turbine generator maintenance will vary as follows:

80 Mw, tandem compound...100%
110 Mw, tandem compound...105%
160 Mw, tandem compound...110%
160 Mw, cross-compound.....125%

3. A boiler and turbine operating at 1,250 psi, 950 F will not result in any savings in maintenance as compared to units using cycles at higher temperatures and pressures.

4. Subject to the variations above, maintenance costs for the turbogenerators were based on 2¢ per year per pound of throttle flow. For the boiler plant the maintenance costs were based on heat input to the boiler, with cost of 9¢ per year per pound of steam output for a single non-reheat boiler being taken as standard. Of the 9¢ per year per pound of steam flow, 4.2¢ is for the boiler and 4.8¢ for related boiler equipment. Since no data were available on the relative maintenance costs of reheat versus non-reheat boilers, it was assumed that a reheat boiler would require 10% more maintenance than a non-reheat boiler. In the case of the turbine no difference in maintenance costs was assumed between reheat or non-reheat units as the extra complication of the reheat arrangements would be offset by lower maintenance resulting from relatively drier steam at the exhaust end. Electrical maintenance costs were estimated for the electric auxiliaries and the generator high tension connections including the 13.8-kv to 132-kv transformers.

Demand and Reserve . . . Cost of power for the various cases was estimated using a capitalized energy charge of $134 and a demand charge of $150 per horsepower.

Arrangement of plant, ie size of turbogenerators, size and number of boilers and whether a unit or steam heater type system is used, determines the amount of additional system reserve which should be installed for the ultimate plant and the cost of this reserve is a justified charge against each scheme. However, the additional installed reserve capacity is available the greater part of the year for economical generation and each scheme is credited with the fuel savings resulting from this reserve capacity and

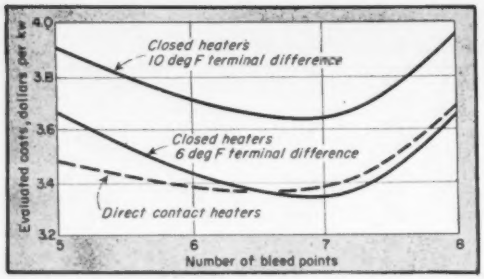


FIG 2—EVALUATED COST COMPARISON of various feedwater heating arrangements, fuel taken at 40¢ per million Btu

TABLE V—Summary of Costs of Pumps and Heaters in Dollars per Kw

	500-psi Heaters			2,200-psi Heaters		
	2 Pairs in Parallel	3 Single, Individ. Heater By-Pass	3 Single, By-Pass around All Htrs.	2 Pairs in Parallel	3 Single, Individ. Heater By-Pass	3 Single, By-Pass around All Htrs.
Installed Cost, $/kw	4.51	4.75	4.59	4.69	5.16	4.90
Added Pump Power, $/kw	1.76	1.76	1.76	....	....	....
Capitalized Maintenance						
Booster Pump, $/kw	0.16	0.16	0.16	....	....	....
Heaters, $/kw	0.06	0.05	0.05	0.13	0.09	0.09
Acid Cleaning, $/kw	0.16	0.12	0.12	0.16	0.12	0.12
Heat Rate, $/kw	0.31	....	....	0.31	....	....
Total Costs, $/kw	6.96	6.84	6.68	5.29	5.37	5.11

based on the difference between its own heat rate and the average system heat rate for that period of operation. The reserve capacity requirements are given in Table 2.

Thirty-two arrangements were calculated and estimated, and the results are shown on Table 1.

For the purpose of placing the differentials on a percentage basis the estimated installed cost of the completed plant, including coal handling and burning facilities, would approximate $200 kw of installed capacity based on present day prices. The data in Table 1 show the following:

1. Size of Turbogenerator . . . Comparing cases 5 and 6 against 17 and 18, the cost differentials in favor of 160-Mw units range from 5 to 6½% when compared to 110-Mw units. Comparing cases 5 and 6 with cases 19 and 20 the differentials in favor of the 160 Mw as against the 80-Mw units is about 12%.

2. Single Boiler vs Two Boilers per Unit . . . Comparing case 5 and 9, 6 with 10, 7 with 11, and 8 with 12 shows the single boiler per unit arrangement to be lower in evaluated costs by differentials ranging from 3.5% to 7.5%.

3. Cross-Compound vs Tandem Compound Units . . . Comparing 5 and 6 with 7 and 8—the differentials in favor of the cross-compound unit based on single boiler per turbine arrangement are of the order of 2½% of the station cost. However, even at the same total evaluated costs, cross-compound units of this size having a quadruple exhaust would be preferred to the tandem compound units which have a triple exhaust, since the former is more likely to provide a higher overload capacity.

4. Non-reheat Cycles Unit System Single Boiler per Turbine . . . Comparing case 5 with 6, 9 with 10, 7 with 8, and 11 with 12 shows differentials of 1.5% to 2% in favor of the 1,450-psi, 1,050-F cycle and this cycle was therefore used for comparison with steam header type systems and also with the reheat cycles.

5. Common Steam Header vs Unit Type Systems . . . Comparing case 5 with case 30 shows that the most economical non-reheat cycle is about 4½% higher on evaluated cost than this reheat cycle. Again comparing case 30 with cases 21, 22 and 25 shows differentials against the header type system of about 2½% to 4% if oversize boilers are used and about 4½% if a spare boiler is employed. Even though the header system was equal in cost to a unit system the latter would be preferred.

6. Most Desirable Reheat Cycle . . . Having found that a reheat cycle is justified, the determination as to how high to go on pressure and temperature in the choice of a reheat cycle to meet the operating conditions of a system will depend in part on the assumption as to what the future average fuel costs will be over the life of the equipment in the area where the unit is to be installed. For our system we have assumed this fuel cost to be 40¢ per million Btu. In Table 3 there is given the break-even fuel cost for the various reheat cycles studied using the reheat cycle of lowest first cost and highest relative heat rate as base, namely the 1,450-psi, 950-F cycle. With an assumed fuel cost of 40¢ per million Btu it follows that the 1,800-psi, 1,000/F-1,000-F cycle was selected.

Therefore the arrangement finally selected was a 160-Mw, 3,600/3,600-rpm cross-compound unit operating on a unit type system with a single boiler per turbine and with a reheat cycle using 1,800-psi, 1,000-F steam at the throttle and 1,000 F for reheat temperature. The unit will have equal division of load at maximum rating, between the high and low pressure shafts, will be designed with a quadruple exhaust and will have duplicate and interchangeable generators.

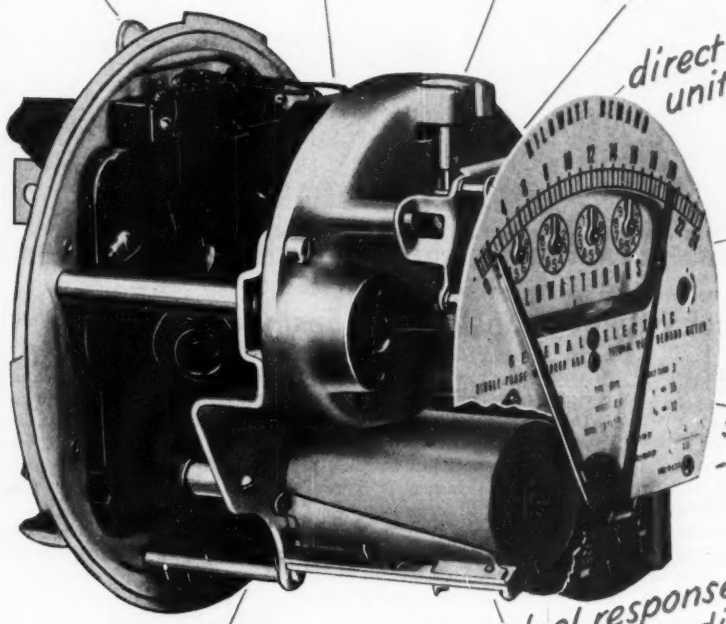
7. Feedwater Heating Arrangements . . . After the basic cycle had been determined, the economics of feedwater heating arrangements were investigated using differing numbers of heaters of both the open and closed type as shown in Table 4.

Based on fuel at 40¢ per million Btu and 6 degree F terminal difference in the closed heaters, the cycle using seven stages of heating with closed heaters, both above and below the deaerator is justified (Fig 2). However if 10 degree F terminal difference is assumed the cycles employing six and seven heaters with open heaters below the deaerators are equal in cost and are about 7% less in cost, respectively, than the seven heater cycle using all closed heaters. It was decided to use a seven heater arrangement with all heaters above and below the deaerator of the closed type.

8. Boiler Feed Pumping Arrangements . . . A comparison was made between various arrangements of boiler feed pumps. The results are shown in Table 5 since the arrangement using two sets of boiler feed pumps with heaters operating at low pressure was about 26% to 30% higher in evaluated cost as compared to the arrangement using high pressure heaters and a single set of boiler feed pumps the latter arrangement was selected. Since the parallel header arrangement is slightly less costly, it was decided to continue our previous practice of using parallel trains above the deaerator.

"DIRECT HEAT"

Watthour Thermal Demand Meter


fits standard meter installations
I-50 features
low watt loss
low maintenance
direct heat thermal unit gives high efficiency
high torque (2300 g.mm. full scale)
stable pointer - no overshoot
ideal response time easily predicted
shortens testing time

TYPE IHM-WATTHOUR THERMAL DEMAND METERS—for more information, call your nearest G-E representative today or write for bulletin GEC-408. Apparatus Department, General Electric Company, Schenectady 5, New York.

603-48

GENERAL ELECTRIC

HOW TO DESIGN • CONSTRUCT OPERATE • MAINTAIN

HANDTRUCK designed by Indiana & Michigan Electric Co handles small distribution transformers as well as larger

50-kva units. It helps keep floors free from oil by carrying transformers (right) in an upright position, saving cleaning time

Handtruck Moves Transformers Easily and Safely

CHARLES H. DE POY

South Bend District Storekeeper
Indiana & Michigan Electric Co
South Bend, Ind.

Distribution transformers as large as 50 kva are handled in the stores department on a handtruck designed by Indiana & Michigan Electric Co. With this new truck one man can move a transformer easily, speedily and safely without spilling any oil, because the transformer is transported in an upright position.

This truck helps keep floors free from spilled oil, saves cleaning time, and makes the work less arduous. It is an improved version of a two-wheeled truck used for handling small size transformers by Consumers Power Co of Jackson, Mich.

The transformer is supported on the truck by hooking the carrying chain under one of the lifting lugs. Different size transformers are accommodated by adjusting the length of the carrying chain in the slots at the top or sides of the truck. When the truck is not in use, it is held in an upright position by the kick stand, which is kept rigid by the holding lever. A coil spring pulls the holding lever into the clear when it is tripped by the operator's foot. With the exception of the wheels, all material for the truck was found in stock or scrap.

Model Substation Speeds Operator Training

J. W. GRONBECK

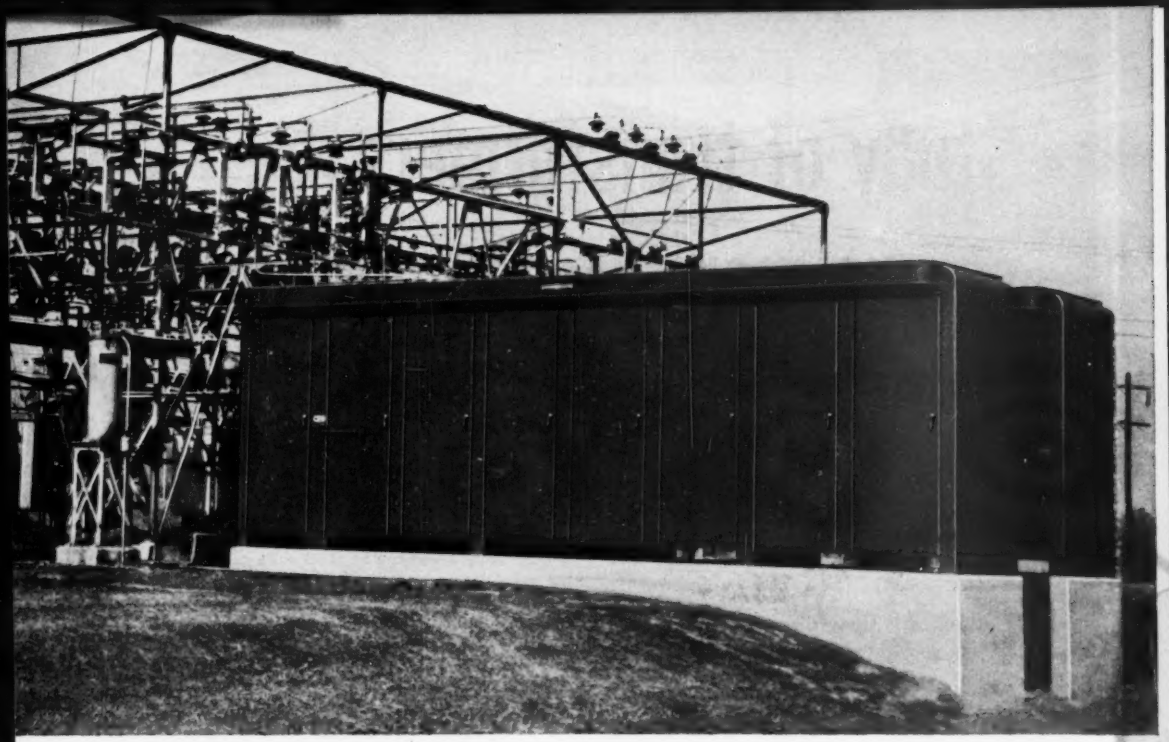
Superintendent Electrical Operation
Narragansett Electric Co
Providence, R. I.

Substation operators are being quickly trained by Narragansett Electric Co with the aid of a model substation. This model has been the principal factor in a program alternating classroom work with exhibits and practical experience in the station to which the man will be assigned.

A rapidly expanding system and frequent personnel changes have made necessary a program more formal than the apprenticeship practice. Modern equipment and preventive maintenance have reduced operating activity and the associated experience. By use of the model, problems in switching—such as shunting a regulated feeder—may be worked out with indication of each step. Tagging procedures, operating rules, and operation during trouble are all a part of the training program.

Controls and indications of the easily built model substation function just like the real thing. The board is ¾-in. plywood, each panel 2½x4 ft, painted and bevelled. The one-line diagram is done in mimic bus and, while abbreviated, is similar to the design of many substations on the system. Shown on the diagram are two incoming 11-kv lines, a double 11-kv bus with bus tie, two transformer banks between the 11-kv and double 4-kv

(*Continued on page* 98)



These G-E switched Pyranol capacitor equipments rated 5100 kilovars at 13,200 volts are installed on the system of an Eastern electric utility. *All* utilities today are finding it pays to install capacitor kvar, some as much as 50% of their peak load.

G-E switched capacitors prove life-savers as loads climb

Short deliveries on equipments. Priced less than $8.00 per kvar

Electric utilities in all parts of the country continue to find that capacitors provide the fastest, cheapest way to increase system capacity.

Where you already have installed a high percentage of fixed capacitors—or where your kilovar loading varies widely in any 24-hour period—you can profit by the use of *switched* capacitors. Automatically switched capacitor equipments can be provided at low cost. The G-E 5100-kvar 13,200-volt Pyranol* capacitor equipment illustrated here, with breaker and automatic control, is priced at less than $8.00 per kvar.

Switched capacitor equipments are available on short delivery. They can be installed in a matter of hours. They provide the least expensive method of releasing system capacity. Call your nearest G-E Sales Office or write for information on how capacitors can help you. Address Sec. 407-31, *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

*Reg. Trade-mark of General Electric Company.

GENERAL ELECTRIC

407-31

Study of transformers shows more forced cooling being used above 15,000 kva

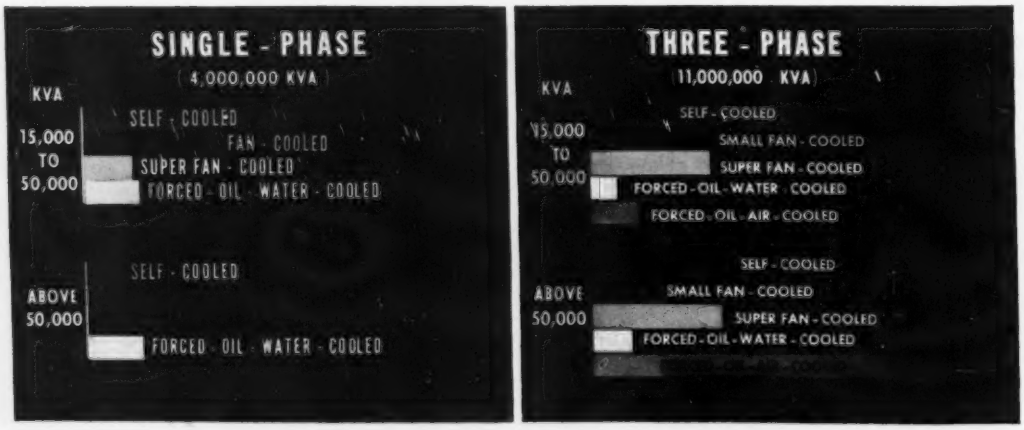
General Electric has recently completed an analysis of approximately fifteen million kva of power transformers, rated 15,000 kva and above.

From this study three trends stand out. First, kva ratings are still climbing, with units as high as 145,000-kva already built and even larger ones being considered. Second, *three* 3-phase units are now being built for every *one* single-phase, as compared to 1940 when there were more orders for single-phase units than for 3-phase. Finally, there is a pronounced trend toward forced cooling, particularly in the higher kva sizes.

This last trend is particularly important because it indicates that a lot more thought is now being given to the economics of cooling than in the past. Today, with at least six types of cooling to choose from, an intelligent analysis of each installation (see opposite page) is necessary if lowest overall costs are to be achieved.

With unequaled experience in building all types of cooling, General Electric is ready and able to provide you with the most economical transformer for your particular application. You can take advantage of this experience by consulting with your G.E. representative before you buy your next power transformer.

This is the way transformer purchases now divide in respect to types of cooling



NO LONGER IS SELF-COOLING DOMINANT. Below 50,000 kva, half of all new single-phase transformers are fan cooled while another 5% are super-fan cooled. Including units above 50,000 kva, about 13% are forced-oil-water-cooled.

IN 3-PHASE TRANSFORMERS, super-fan cooling is definitely on the increase, and now accounts for 23% of the total. Most startling is that 40% of all units above 50,000 kva are now forced-oil-air-cooled.

Type of Cooling*	First Cost (in per cent)	Impedance (OA = 1)	Core Loss (OA = 1)	Copper Loss (OA = 1)
Self-cooled (OA)	100	1.0	1.0	1.0
Fan-cooled (OA/FA)	91	1.25	0.85	1.35
Water-cooled (OW)	85	1.0	1.0	1.0
Super-fan cooled (OA/FA/FA)	80	1.67	0.75	2.1
Forced-oil-air cooled (FOA)	75	1.5	0.8	2.0
Forced-oil-water cooled (FOW)	70	1.5	0.8	2.0

Note: Approximate figures above are based on a 50,000 kva, 138-kv transformer.
* Substation units are usually types OA, OA/FA or OA/FA/FA. Generating station units are usually FOA or FOW.

These are the considerations affecting the choice of transformer cooling

FIRST COSTS—In the table above, different types of cooling are arranged in descending order of first costs. *Relative* first costs will generally fall in this same order for units 50,000 kva and higher.

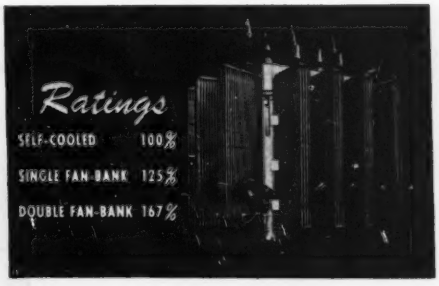
IMPEDANCES—Minimum standard impedances for FOA and FOW transformers are nearly 50% higher than for self-cooled units. However, this is generally a minor problem at step-up stations where losses have minimum cost and where voltage drop can be compensated for by modern generators.

LOSSES—To first cost must be added both the expense of supplying energy losses (copper and iron), and the amount of lost revenue which results from having to supply these energy losses. The total loss can be capitalized and added directly to first cost, or can be computed on an annual basis and added to yearly carrying charges.

INSTALLATION COSTS—These must be added to above costs, but will vary widely with conditions at the site. Generally, minimum installation cost is achieved with FOA transformers. All General Electric transformers are shipped in an *upright* position—a factor which greatly facilitates installation.

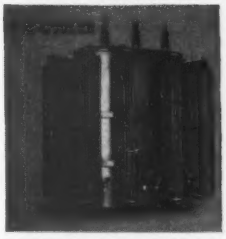
A Special Look at the Super-Fan-Cooled Transformer

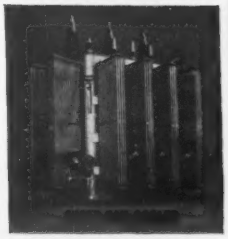
This comparative newcomer, with its three separate ratings, is fast increasing in popularity. Its first cost is between the self-cooled and forced-oil types—so it is the least expensive transformer if you want to avoid oil pumps. It can be purchased without fans where future load growth cannot be predicted—and fans added as necessary. Finally, the industry seems to favor the super-fan-cooled transformer for unattended areas, probably because it has at all times a self-cooled rating.

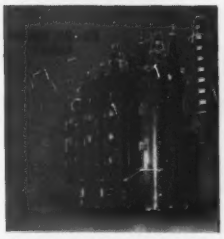


Through the courtesy of American Institute of Electrical Engineers, we have reprinted an article, "The Choice of Main Power Transformers for Generating Stations," which is pertinent to this whole question. Ask for GET-2225. Write to Apparatus Department, General Electric Company, Schenectady 5, New York.

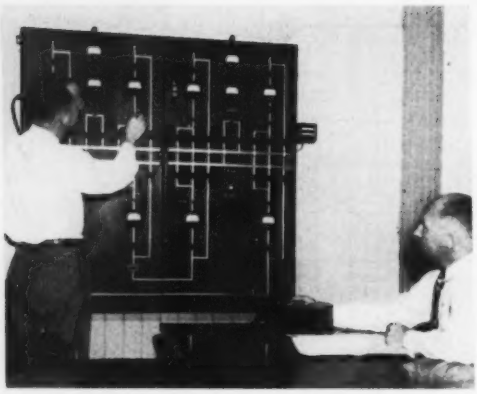
401-15



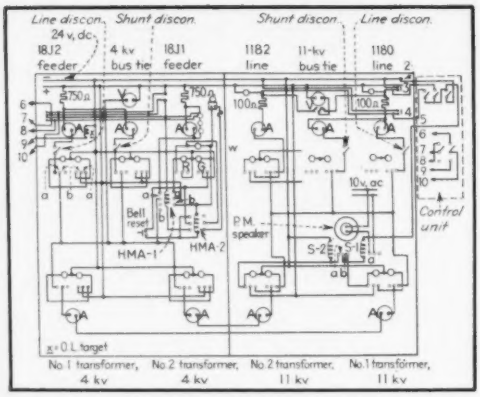




GENERAL ELECTRIC



MODEL SUBSTATION duplicates actual switching and tagging operations. Control unit is on the desk. G. A. Baltteim (left) acts as student operator and the author as instructor



CIRCUITS, from rear of panel assembly, showing how 24-v relay in control circuit of each transformer high-side breaker energizes magnetic speaker to give realistic 60-cycle hum

Operator Training

(*Continued from page* 94)

buses, and two 4-kv feeders (one of them regulated) with a 4-kv bus tie. There are circuit breakers on all lines, transformers and feeders, and a shunt connection on each breaker. Also included are balance power and ground relay cut-out switches.

The model is operated at 24 v dc, with a demand of 200 ma, from 18 No. 6 dry cells. Precision milliammeters and millivoltmeters were rescaled to read in station amperes and volts. Supervisory-type controls and lamps are used for circuit breaker operation and for potential and circuit breaker indication.

Sound has been added for realism. When a transformer is energized, a 60-cycle hum is heard as a result of energizing a magnetic speaker through a bell transformer from the regular 60-cycle supply. A 24-v relay in the control circuit of each highside breaker is picked up to energize speaker when transformer is placed in service.

Supply to each incoming line is controlled by the instructor through a cable running to the board from the control unit. Thus, the instructor can simulate actual conditions by tripping a feeder or killing the substation without warning to the operator.

Instructors are cautioned to follow every basic rule of operation when working with the board. Every order and operation is kept in a station log.

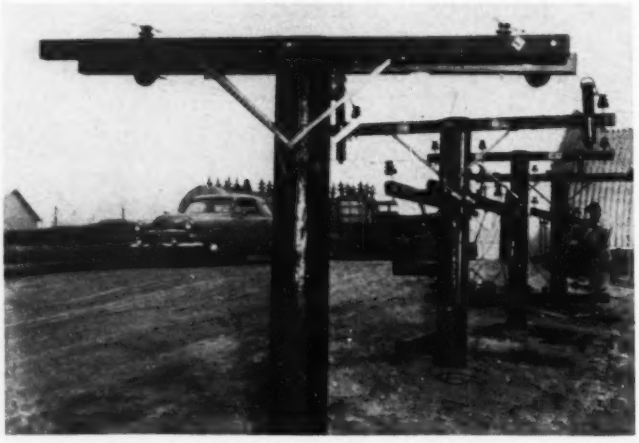
Eye-Level Pole Tops Simplify New Design Problems

HAROLD M. WILLIAMS
Electrical Inspector
California Electric Power Co
Riverside, Calif.

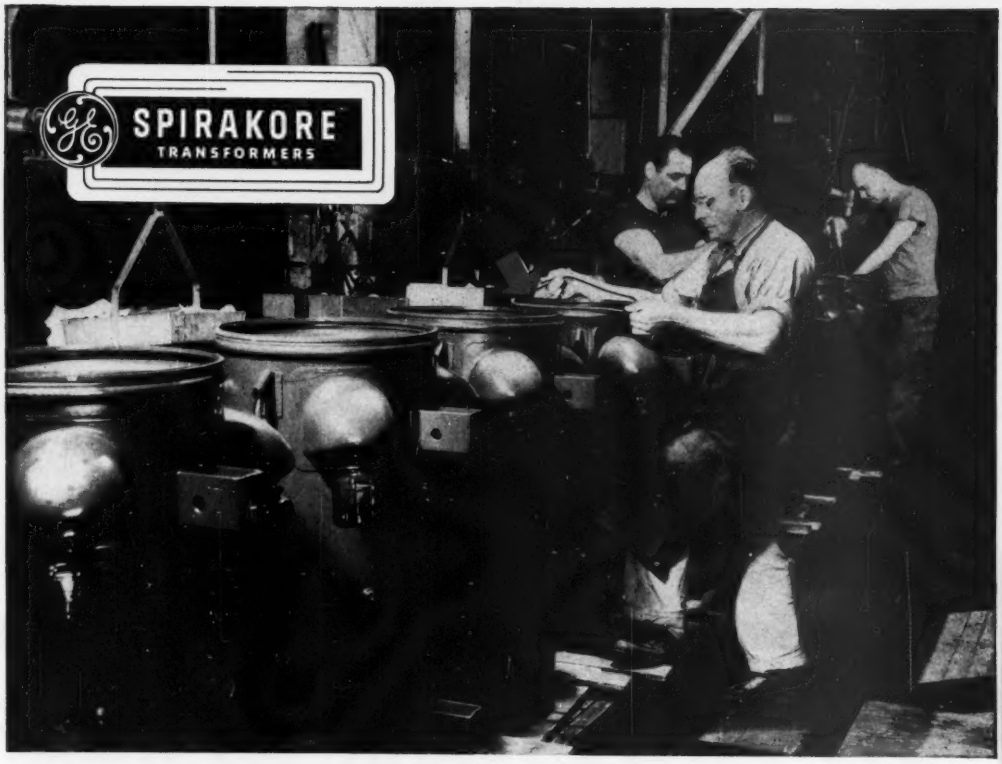
Eye-level evaluation of pole-top design has helped California Electric Power Co draw up a set of standards for 12-kv construction with a minimum of subsequent alteration in the field. When the engineering department was faced with the necessity of designing for rapidly expanding 12-kv distribution, it was decided to set up the simple laboratory to simplify the work as much as possible.

A discarded full length pole was cut into four 10-ft sections which were set as shown. Proposed designs are actually checked for climbing clearances, ground clearances, general ease or difficulty of assembly and connec-

(*Continued on page* 102)



POLE-TOP DESIGNS are tested and proved in working laboratory set up by California Electric Power Co. Four 10-ft pole stubs are used to check clearances, simplify designs, and try new methods of construction with minimum time and effort



AIR-TIGHT SEAL MAKES SPIRAKORE* TRANSFORMERS LAST LONGER

Breathing is stopped in General Electric Spirakore transformers. A Nitrile rubber gasket—resistant to oil, age, sunlight, or operating temperatures—seals every opening in Spirakore transformers. Sealing is so complete that hottest summers and coldest winters won't draw moisture or dust into the tank. Transformer life is prolonged.

With this sealing *accessibility is actually improved.* Unclamp the tank cover and it lifts right off. No adhesives to break—no surfaces to clean before resealing. You even re-use the gasket.

This better sealing is only one of the reasons why Spirakore is the finest transformer you can buy. The full story is told in our new bulletin GEA-5400. If you haven't received your copy ask your G-E representative, or write *Section E 402-103, Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

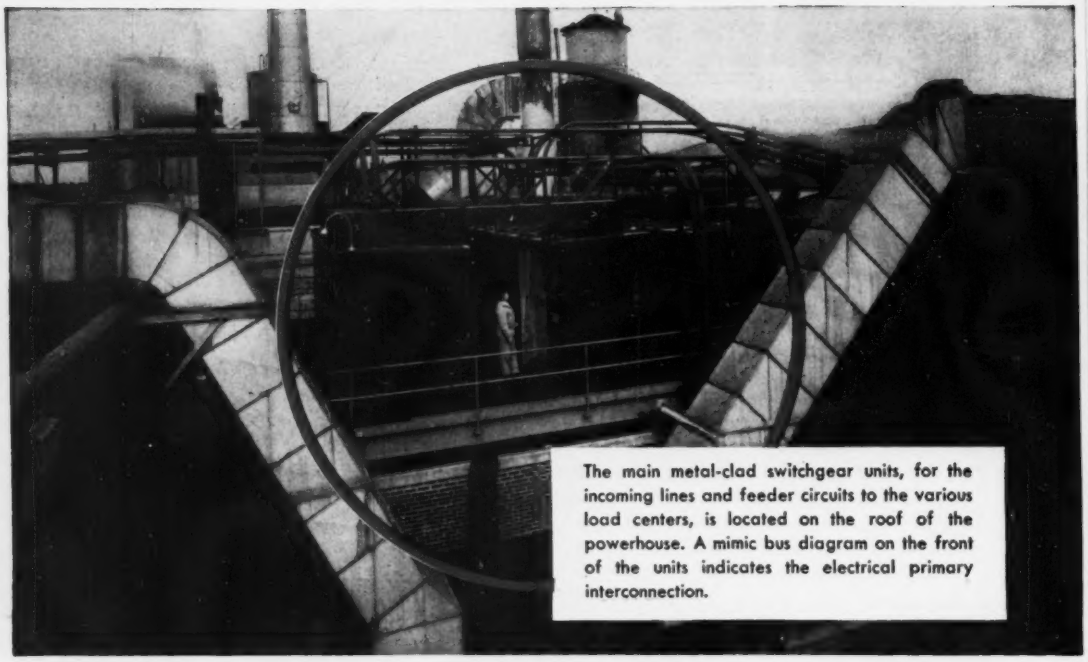
* Registered trademark of the General Electric Co.

On large tanks, Nitrile rubber gasket of circular cross-section is compressed as shown. A ring welded to the tank keeps the gasket in place and prevents too much compression.

On small tanks, a Nitrile rubber gasket of square cross-section is compressed between rim of cover and deep-rolled flange on tank. Shown uncompressed.

402-103

GENERAL ELECTRIC



The main metal-clad switchgear units, for the incoming lines and feeder circuits to the various load centers, is located on the roof of the powerhouse. A mimic bus diagram on the front of the units indicates the electrical primary interconnection.

PUTS SWITCHGEAR ON ROOF

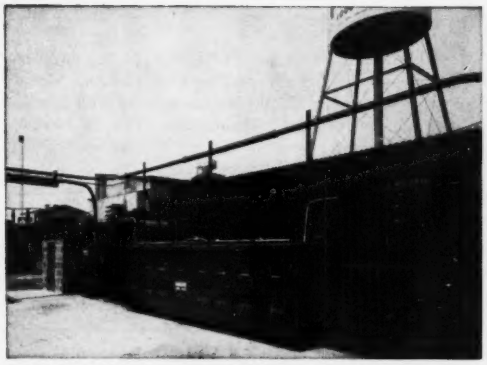
saves 10,000 sq. ft. of floor space

Indoor space limited—installation made with almost no interruption of production —Maintenance will be greatly simplified.

When Scott Paper Company, of Chester, Penna., completely revamped its electrical system to take care of expanded plant output, it made one rather unusual decision. Because indoor space was limited, it put all its switchgear and load-center units on the roofs of the various buildings. The incoming utility power lines, at 13,200 volts, terminate in General Electric outdoor metal-clad switchgear on the roof of the powerhouse, and the 575-volt distribution system is fed through G-E metal-enclosed gear located on roofs of the individual buildings. Distribution between buildings is at 13,200 volts with step-down load-center units.

This type of installation has proved to have a number of advantages. In the case of Scott Paper, 10,000 square feet of badly needed floor space became available for paper making. The entire installation could be made during normal working hours, yet did not interfere with plant production. Likewise, routine inspection and maintenance can be done without entering the manufacturing areas. All breakers are of the easily-removable type that is so easy to maintain and inspect.

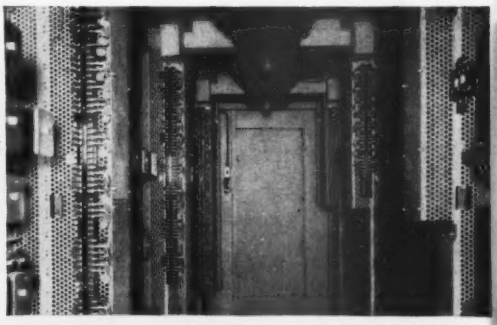
What's more, there's plenty of space for expansion. Provision has been made to double the capacity—by adding transformers and switchgear—when still more electric power is needed later. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*



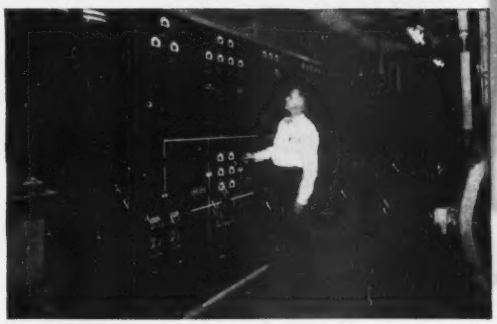
A double ended load-center unit feeding the large 2300-volt motors in one of the main buildings. Unit consists of two power transformers with air-interrupter disconnects, and metal-clad switchgear units for metering and for the four magne-blast air circuit breakers.

One of several single-ended load centers, which can be doubled in capacity later by adding a second transformer and low-voltage switchgear units. This particular unit uses metal-enclosed gear with draw-out air breakers to 575-volt feeders which serve the paper finishing units.

New switchboards simplify control — Increase safety



BEFORE Front and rear views of the old switchboard which handled all the plant's power at 575 volts. Open buses, breakers, knife-switches, and resistors were a definite hazard — and one bad short circuit or fire could have closed down the plant.



AFTER Main switchboard is now simply a control board. Incoming line and feeder circuits can all be closed from this one location. No power lines or high voltage is brought to this board at all—and there are no open buses or switches to form a hazard to personnel.

854-33

GENERAL ELECTRIC

Eye-Level Pole Tops

(*Continued from page* 98)

tion, and compliance with California state safety orders.

New methods of construction, such as bolting transformers directly on the pole, are investigated, and standards of other utilities are set up for comparison and possible modifications. Poles have also been used to acquaint new men with construction standards of the company, although no plans have yet been made for using them for training linemen.

Chief advantage of the investigations has been to eliminate designs which were inconsistent with practical field construction. This in turn has greatly reduced the instances where actual construction does not conform to the standard print set up by the engineering department.

Adjustable Grip Removes Glass Meter Covers

E. C. KOHL
Meter and Service Dept
The Ohio Power Co
Coshocton, Ohio

The local-made grip illustrated can be used to remove glass covers of A-base watthour meters, particularly those covers which have become very tight and difficult to remove. It was developed to obtain a tight grip on these covers and is deemed the best from a safety viewpoint. In addition it is also simple to use, relatively inexpensive and easy to store or carry.

This cover grip utilizes a standard laminated fiber fuse puller and two pieces of either leather strap or canvas belting. The latter is lower in cost. Loop of one belt is for small meter covers and the other loop for large covers. Ends of the belts are attached to the jaws of the fuse puller. This is done by threading a No. 8 copper wire through the hollow rivets in the jaws and then soldering the wire ends securely.

The material cost of this grip was about $2.25 for fuse puller and leather straps, and $1.75 with canvas belting.

ADJUSTABLE GRIP having both small (left) and large (right) loops is used to remove glass covers on A-base watthour meters, especially tight-fitting covers

If a cracked glass cover is gripped with this device, the user should keep his arm from under the cover in case it should break and fall on his hand or arm. However, a simple metal enclosure for clamping onto the base of broken glass covers is safer to use.

Large Generator Shaft Repaired in Place

JULIO COLON
Cia Impulsora de Empresas Electricas, S.A.
Mexico City

On-the-spot repairs to the shaft of a hydro-generator saved Cia. Impulsora de Empresas Electricas, S.A., of Mexico, a long shutdown and the expense of shipping the rotor to the factory. A constantly increasing vibration had developed in an 18,750-kva, 13.8-kv, 450-rpm generator which was traced to excessive play between generator shaft and upper collar of the Kingsbury thrust bearing. Truing the shaft took 40 hr while the unit was shut down for 21 days.

The procedure is not new, but has been used elsewhere with success. Repairs consisted of truing the 11⅜-in. generator shaft and counterboring the collar for a length of 11 in. to allow for insertion of a cast iron bushing. Generator shaft was turned in place by means of a turning mill which rotated the cutting tool around the shaft. A small lathe carrying the cutting tool was supported by a welded steel plate cylinder which looked somewhat like a 50-gal drum with heads at each end. A longitudinal cut on the drum gave access to the tool holder and permitted inspection of the shaft.

Upper head of the turning mill was bolted to a housing, and a ball bearing supported by a flange was bolted to the horizontal surface of the generator shaft. The lathe feed screw was extended through the upper head of the drum and driven by two small sheaves,

(*Continued on page* 108)

"Even *the* UNUSUAL can include *the* CONVENTIONAL"—REVERE

ATMOSPHERIC TOWER OVERHEAD CONDENSERS

Each battery of 6 has a total capacity of 60,000,000 BTU/hr with 18,000 square feet of effective surface. Made by Henry Vogt Machine Co., Louisville, Ky. Revere Naval Brass fixed end plates are 38½ in. diameter by 2⅛ in. thick, floating end plates are 35¾ in. diameter by 2 in.

These Henry Vogt Machine Co. condensers have an unusual feature: vapor belts in the shells to feed more copious and uniform flows of vapor than are obtained by the usual single nozzles.

Inside the condensers, the tubes are rolled into Revere Naval Brass Tube Sheets.

The use of Revere Naval Brass for this purpose is completely conventional in condenser building practice. Revere Naval Brass is corrosion resistant, strong, tough, durable. Every mechanic on the production line knows how to fabricate it. Every maintenance man knows how to treat it when doing a servicing job. Thousands of Revere Naval Brass plates are in daily use in condensers and other heat exchangers built by all the best manufacturers. Some of these plates have been in service for decades.

Revere has alloys for your unusual design features too. Some of these are conventional, made to do unusual jobs because the Revere Technical Advisory Service knows where and when to recommend them. Others are less well known.

When you work out an unusual design you want to concentrate your attention on the unusual features. Under those conditions, use the time tested, service proven, utterly dependable standard Revere alloys in the standard parts of your design and you will be able to forget those parts and keep your attention where it is needed.

For any problem at all that involves the use of metals, consult the Revere Technical Advisors. Their knowledge, skill, experience, contacts (yes, we ask questions as well as answer them) can add up to money in the bank for you.

REVERE 150 YEARS OF SERVICE TO AMERICA

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.—Sales Offices in Principal Cities, Distributors Everywhere.

SEE "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY

Corona Loss Variation for Different Conductors and Weather Conditions

Kilowatt losses on a 3-phase line are charted for 250 to 550 kv and 20 to 45-ft conductor spacing

Corona loss in kilowatts is based on manual and recorded data for both fair weather and foul weather.

Definitions of the terms are:

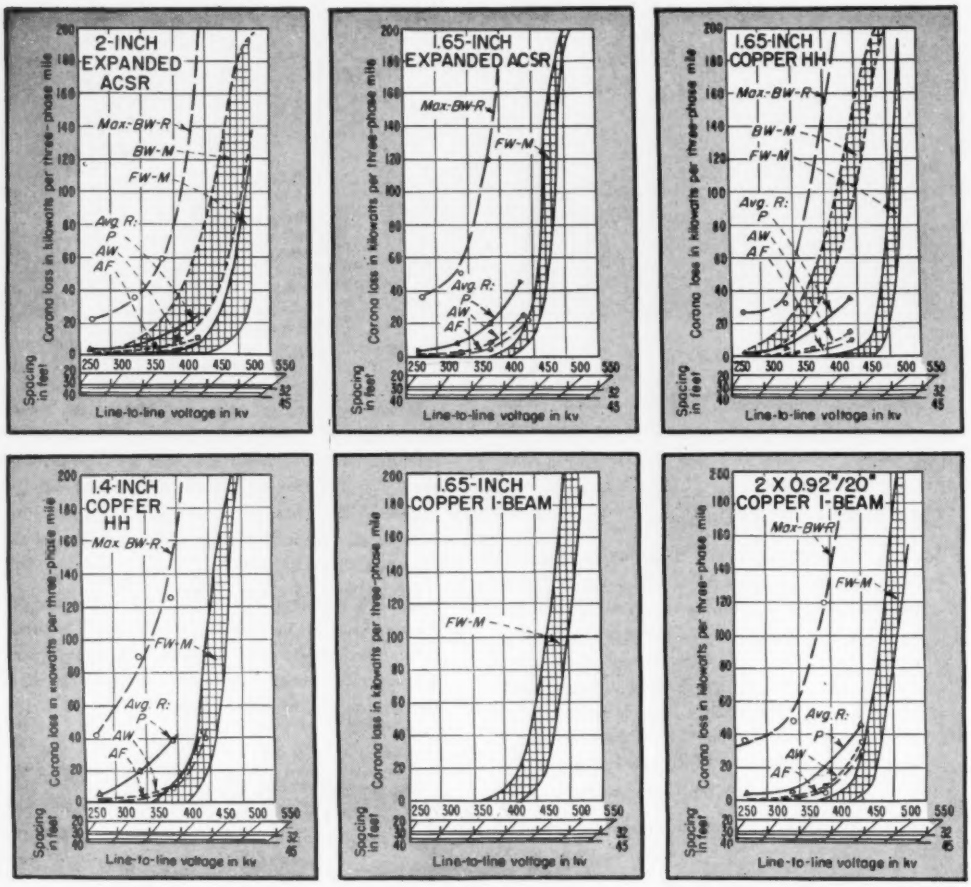
"Manual" data are values obtained from an individual test or observation made for a specific purpose. Manual data has been reduced to unity air density.

"Recorded" data are values obtained from photographic recorder and graphic charts.

"Fair weather" is a condition of no visual abnormalities such as rain, fog, snow, sleet or smoke in the vicinity of the conductor. "Foul weather" refers to all other conditions.

"Apparent fair weather" period is such time during which no indication of precipitation occurs on the rain gage. "Precipitation" period is the converse.

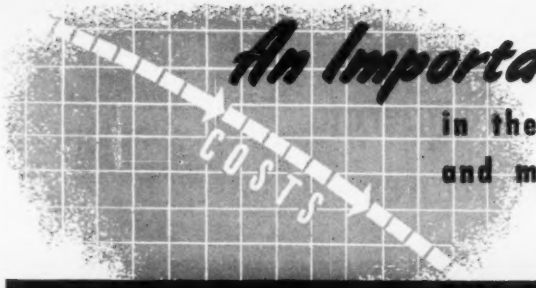
Adapted from a paper entitled "Corona Investigation on Extra-High-Voltage Lines—500-kv Test Project of the American Gas and Electric Co.," by AIEE Committee on Transmission and Distribution, and presented before the AIEE Winter General Meeting, Jan. 22-26, 1951.

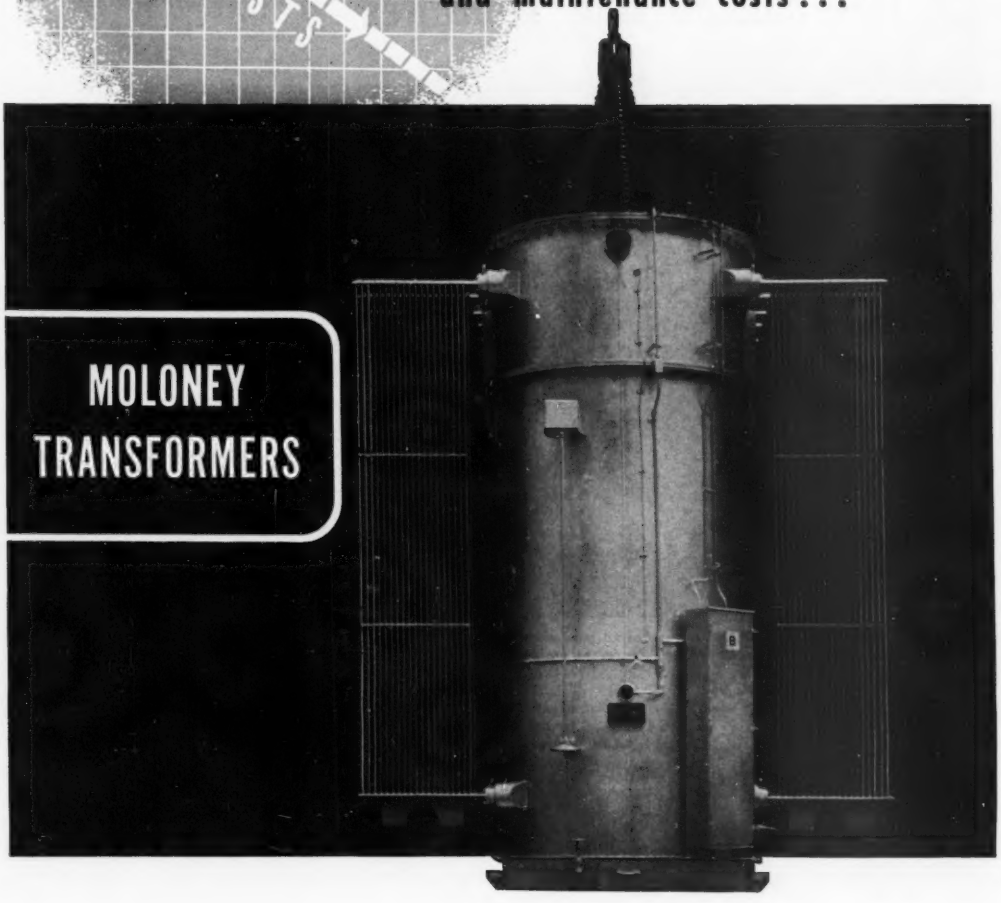


LEGEND . . . M=manual data; R=recorded data; P=precipitation; FW=fair weather; BW=foul weather; AF=apparent average fair weather; AW=all weather.

An Important Consideration

in the reduction of operating and maintenance costs . . .





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A Guide for Successive Numbering Of Transmission Line Structures

Procedure for serial numbering is applicable for direct lines or in normal direction of flow of power, adding or subtracting structures in a line and rerouting of lines. This is an adaptation from construction standards of Wisconsin Power & Light Co

Structures of transmission lines and the poles of some important distribution lines are numbered successively to facilitate their maintenance and operation. This is a serial-numbering system and has no relation to a co-ordinate system used to designate the location of poles for a property record.

Line structures are numbered from their point of supply, starting with the first structure at the substation as number 1, and continuing serially to the next major supply station or other designated point.

Lines which are supplied from either end, that is, have alternate sources, are numbered from one end only. One of these sources is designated as the "normal" source from which structure numbering is started.

Numbers are attached to every 5th structure, where spans average less than 350 ft; where spans average more than 350 ft, then every structure should be numbered.

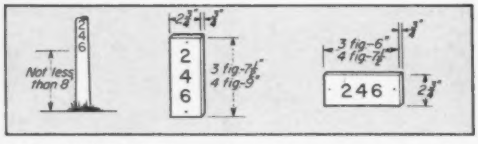

FIG 1—WOOD POLES: Numbers 1.5 in. embossed pure aluminum Gothic figures attached to pole with: Brass or galvanized steel escutcheon pins (round head nails) No. 15 B.W.G. (0.072 in.) 1 in. long (725 pins in 1 lb.) STEEL STRUCTURES: Number plates bolted or wired to the structure. Figures same as for poles, but attached to boards with 15 B.W.G. (0.072 in.) ¾-in. long brass or galvanized steel escutcheon pins, or No. 2 (0.086), ⅝-in. long, round head brass screws. Boards should have two coats of black paint

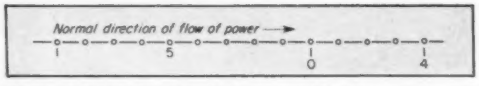

FIG 2—POLES NUMBERED in normal direction of flow of power. When numbering poles on a transmission line of unnumbered poles, place a 1 on the first pole at the point of normal supply and a number on each 5th pole of the line. First and last pole shall always be numbered.

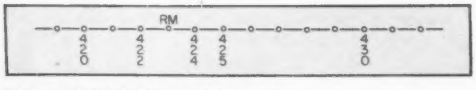

FIG 3—SINGLE POLE REMOVED. When necessary to remove a pole from a transmission line, the adjacent preceding and succeeding poles, to the one removed, shall bear their respective pole numbers. The number which was borne by the pole removed is dropped

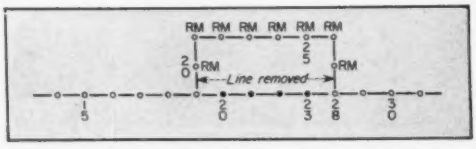

FIG 4—SEVERAL POLES REMOVED. When a rerouting of a section of transmission line requires the removal of several poles and the setting of fewer poles than were removed, the numbering shall be continued consecutively from the old numbering through the new poles. The last new pole shall bear its proper new number while the adjacent old pole shall bear its proper number in the old numbering. For example, the last new pole bears No. 23, the adjacent old pole bears No. 28 (old numbering). The numbers dropped are 24, 25, 26, and 27 and, of course, represent the poles left out in the rerouting. Pole numbers should be attached to poles 20, 23 and 28

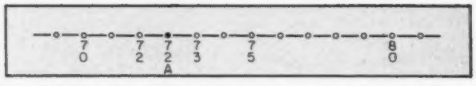

FIG 5—SINGLE POLE ADDED. When necessary to place an additional pole in a transmission line, it shall be given the same number as the preceding old pole and the letter A added, as shown above. If two or more poles were added consecutively, they shall be numbered 72A, 72B, etc. The number of an additional pole should be attached to the pole

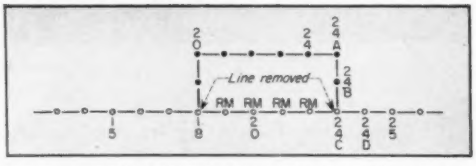

FIG 6—SEVERAL POLES ADDED. When a rerouting of a section of transmission line causes the removal of several poles and the setting of more poles than were removed, the newly set poles shall be numbered consecutively using all available numbers without repeating; then using the last number and adding the letters A, B, C, etc., as shown above. Old poles 19, 20, 21 and 22 were removed and new poles 19, 20, 21, 22, 23, 24, 24A and 24B were added. Numbers shall appear on poles now numbered 20, 24A, 24B, 24C, and 24D

LEGEND . . . Circle=present pole; dot=proposed pole; RM=pole to be removed

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- Produces very high clamping pressure resulting in low resistance joints on stranded wire.
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- Exclusive helical serrations in both body and cap, conforming to the lay of stranded wire, together with the high clamping pressure produce a joint which will not pull apart. Thus the Blackburn Two-Bolt CLAMP is excellent for dead ending.
- It's made of high strength alloys throughout. Its extra strength maintains the high "pressure between wires" indefinitely. Thus it makes a lasting, trouble-free connection.
- It's compact and easy to tape — makes a neat joint.
- It's simple and easy to install.
- Made in sizes 1/0 to 1000 MCM.

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*Wire Size Used*_____

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*Company*_____

*City & State*_____ EW

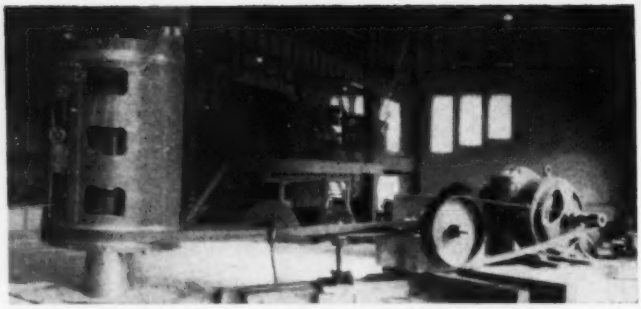
Generator Shaft Repaired

(*Continued from page* 102)

as shown in illustration. Shaft adjustment was provided by four 6-in. diam ball bearings supported on eccentric pins; these pins were mounted on the lower head.

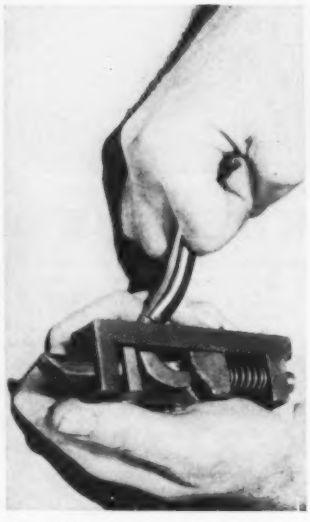
A 3-in. band around the drum circumference was machined to serve as a sheave for an endless belt driven by a motor. Cutting speed was 50 fpm, corresponding to about 15 drum revolutions per minute.

The cast iron bushing that was inserted between thrust collar and shaft was made 0.015 in. larger than the counter bore of the collar. Bushing was covered with 220 lb of dry ice and allowed to contract for four hours; expansion took place in the thrust collar. Collar was then bored 0.001 in. larger than the shaft and trued up. The collar, before inserting it, was placed in a closed space and heated with 500-w lamps until bore diameter increased 0.010 in.



TURNING MILL assembled on the generator shaft is rotated by a motor-powered endless belt riding in a circumferentially-machined "sheave". Lathe feed screw extending through upper head of the drum is driven by V-belt on two small sheaves

Grating Lock Features Safety and Security



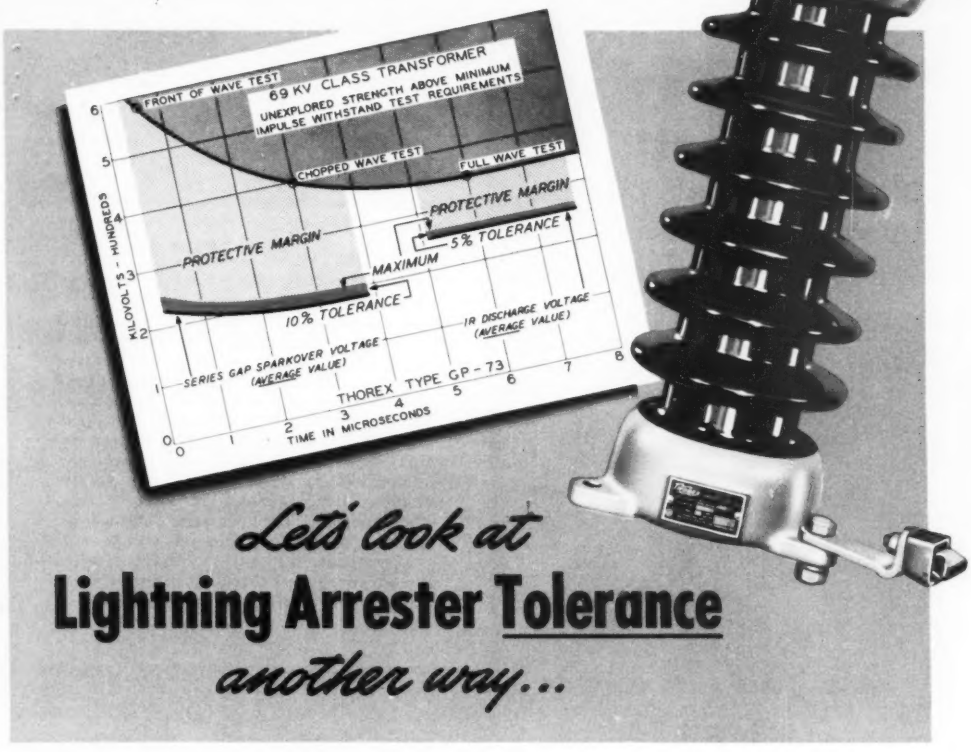
CUTAWAY of lock shows how key forces back bolt. Key is also lifting handle

KEY OPENS LOCK and lifts network transformer vault grill in one motion. Lock is said to be practically "pick-proof." Inventer Al Castle shows how lock works

A new sidewalk grating lock is claimed to be not only simple and rugged but also practically "pick-proof." This lock eliminates personal contact with the unsanitary conditions that usually accompany ordinary padlocks which are installed on gratings in congested streets and sidewalks. Proper closing is assured by a "tell tale" at the rear of the lock which indicates when grating is not properly secured. Because the lock can be unlatched from the underside without a key, personnel cannot be trapped if the grating falls shut.

This new lock is bolt-operated by a specially made hook-key that forces back the bolt and lifts the grill, all in one motion. The lock is self closing and is integral with the grating, presenting no hazardous projections. Potomac Electric Power Co has ordered 250 of them and has made them a stock item. The lock was designed and developed by Alfred B. Castle, substation department, Potomac Electric Power Co, Washington, D. C. He made his first lock in the basement workshop of his home. (See "New Equipment," 126, Dec. 18 issue.)

HI-TENSION NEWS *Junior*



Let's look at
Lightning Arrester Tolerance
another way...

You add it to average ratings—But you take it out of Protective Margins—
Can you afford to waste any arrester protection?

● The story of lightning arrester tolerance is told in graphic terms in the accompanying curves relating to a typical 69-kv transformer. All published arrester values are *average* ratings to which tolerance is *added*. Between these basic *average* ratings and the demonstrated strength of the transformer exists a zone called the "Protective Margin." It's not so important that tolerance is added to published values as it is that tolerance is *deducted* from that vital Protective Margin. This is just a different way of looking at the same thing -- but an important difference!

-- And while you are considering tolerance, bear in mind that the O-B Thorex arrester has by far the closest tolerance ratings offered on the American market; giving you wider, more usable Protective Margins. Investigate this phase of the O-B Thorex.

Ohio Brass

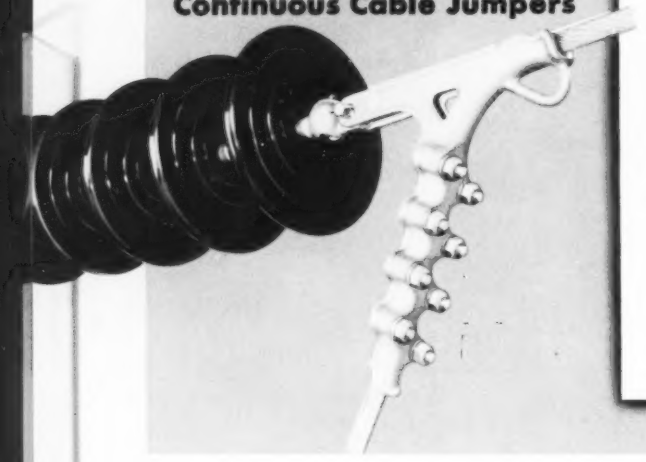
MANSFIELD, OHIO, U.S.A.

(B)

HI-TENSION NEWS *Junior*

—and a Saving to Boot!

O-B Hi-Lite Strain Clamps Make Possible Modern Continuous Cable Jumpers



● It would be well worth a price premium to avoid splices in the jumpers at transmission line strain points. These are well-proved trouble makers. The fact is, however, that you can get rid of these splices and save both money and trouble to boot!

O-B Hi-Lite strain clamps are basically inexpensive. They require no other field application equipment than a common hand wrench. No skill is required to install them correctly. Both the steel and aluminum strands are held in the entire length of the clamp jaws, without question. Clamps are subject to inspection for tight grip from the first to the last day of the line's life. They will develop full working strength of conductor cables. And, because Hi-Lite strain clamps attach around an uncut cable, they permit the modern stringing-through practice at jumper points.

If you are not fully acquainted with the advantages of this O-B clamp, it will justify your serious investigation.

O-B Clamptop

Makes Sound Radio-Proof Insulator Design Really Work!

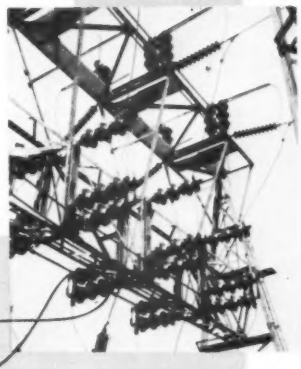
You can design radio-silent insulators, but you can't make them *work* properly with loose tie wires. And even the best tie may not stay tight under the vibration and strains of average service. In place of unreliable tie wires, use the O-B Clamptop that holds the conductor between screw-compressed jaws. The high radio-silence of this insulator is utilized 100 per cent and does not deteriorate with time. No skill is required to install the O-B Clamptop in just a fraction of the time needed to put on the older tie wire -- and the insulator stays quiet for the life of the line!

You Count Your Money

. . . On the Last Day of a Station Insulator's Life . . . Not the First!

● Let's admit it, all station insulators are very much alike -- the first day they are made. But there is another very important day that tells you what you really got for your dollar -- the last day. They aren't so much alike then!

You can find O-B station insulators on the job, still delivering full value, after 30 or 35 years. Their owners have had a big dollar's worth so far, and more yet to come. Important as that first day may be, the *last day* is when you count your money. That's the day you'll be glad you insulated your stations with O-B.



31 years old— still fully efficient

26 Years...

of tough going can't touch O-B insulation

● Consider these facts: Age of line, 26 years. Length, approximately 70 miles. Terrain, remote hilly country. Weather conditions, exceptional exposure to winds and heavy icing; 46 annual thunderstorm days . . . Not the most favorable territory for making operating records. Yet the owners report that not a single O-B suspension insulator has ever been removed due to any inherent defect. You can have this same performance -- this same peace of mind -- by specifying O-B on your next transmission project.

Ohio Brass

MANSFIELD, OHIO, U.S.A.

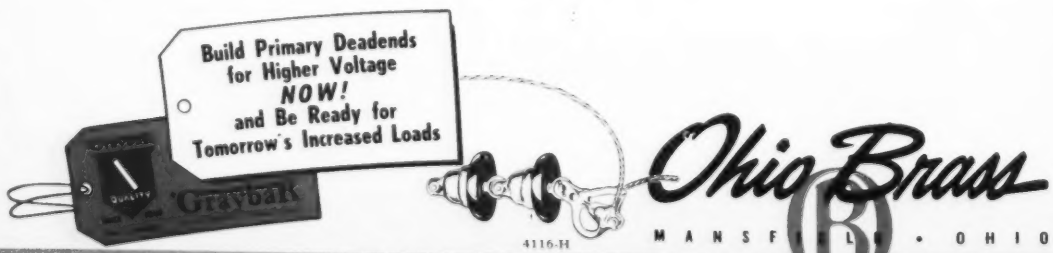
OB

HI-TENSION NEWS *Junior*

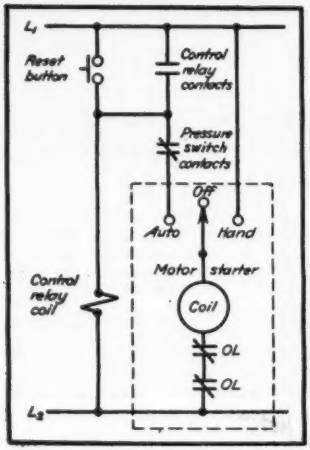
You have to fit the FUTURE

How tight are your "distribution pants?" Can you grow into a residential power demand of 5000 kwhr per year -- the average load expected by 1960 -- without splitting them?

Many companies, with an eye to the future, are preparing their systems by rebuilding low voltage primary deadends *now* for an inevitable voltage increase. A standard assembly, consisting of two O-B suspension insulators and a Universal Strain Clamp will put extra room for growth in your "distribution pants" so that when tomorrow comes, a major item of preparation will be ready.



Low Voltage Protection With 2-Wire Control



RELAY and push button added to motor starter circuit provides low voltage protection desirable under some conditions

ELECTRICAL ENGINEERING IN INDUSTRY

FRANK E. REEVES
Director Electrical Instructions
Baton Rouge, La.

Here is a simple method for preventing motor drives with two-wire control from restarting automatically after a low-voltage or voltage-failure condition. Such a need may exist under either of these conditions:

When low voltage or voltage failure has disrupted other equipment or process and complete restarting must be delayed or it must be started in proper sequence.

When so much automatic load is connected to the same supply that restarting of the several equipments must be staggered to avoid excessive initial demand on the power source.

A single-pole normally-open relay and single-pole normally-open push button is used in conjunction with a motor starter equipped with a standard "Hand-Off-Automatic" selector switch. After the line is made alive, the reset push button is actuated. Normal automatic operation is initiated by turning the selector switch to "Auto." If voltage drops to about 25% of normal,

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FOR HELP WHEN YOU NEED IT
— OR BEFORE

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So, whatever your fire protection problem, let an expert C-O-TWO Fire Protection Engineer help you in planning complete and up-to-date fire protection facilities now. Write us today . . . tell us about your particular fire hazards, our experience is at your disposal . . . there is no obligation of course.

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Squeez-Grip Carbon Dioxide Type Fire Extinguishers • Dry Chemical Type Fire Extinguishers
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or fails completely, the relay lock-up circuit is broken. The motor will not restart automatically when voltage is restored to normal until reset pushbutton is actuated.

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Condenser-Mounted Turbine Shows Little Vibration

R. F. CUMMINGS
Vice-President in Charge of Engineering
Burns & Roe, Inc
New York, N. Y.

Hudson Plant of Rockland Light and Power Co pioneered the use of a turbine (20 Mw) mounted on its condenser for support as described in "Electrical World," Feb. 12, 1949. Not only is the installation affording economy of investment, accessibility and simplicity but the vibration is as small as, or even smaller than, anticipated.

Early consideration of the design had contemplated a small-scale model for studying the vibration potentiality but the almost certain differences in welding and other techniques of fabrication would make the model an uncertain index of performance of the full-scale commercial unit. It was decided to rely on tests on the unit in service.

Methods of Gauging Vibration

Several methods of gauging vibration were considered, such as (1) Electric dynamic fybrometer which consists of a transformer, a microammeter, and a cylindrical handle and permits instantaneous accurate measurement, without extraneous support, of defiection of side plates of the condenser or (2) a Whetstone Gate which would indicate deflection by measuring strain on wire secured on points of the condenser side plates. We decided to compare instrument readings taken during no-load spin of the unit, while on test block at the factory, with normal erector's readings taken after the unit was placed in service on the condenser superstructure foundation.

Field personnel of the turbine manufacturer took vibration readings with the aid of portable dynamic balancing equipment during the initial spin and after adding a five-ounce single weight to the last-stage turbine wheel for balancing. The vibration

Even though it's better- TRIANGLE costs no more

In everything you buy, there is always one product which, for quality and value, stands head and shoulders above the rest. In electrical wire, cable and conduit it's Triangle—and yet, Triangle costs no more!

Why can we say Triangle is better? Take "Glazon" Building Wire, for instance. Incorporated in the cover of this wire is Fiberglas braid which gives the cover wearing qualities unheard of before.

Another example of Triangle quality is Rigid Conduit—finished by an exclusive process which assures "no flaking" even under the most severe bending.

Every Triangle product—wire, cable, or conduit, is made to be better. Try Triangle on your next job—and see for yourself.

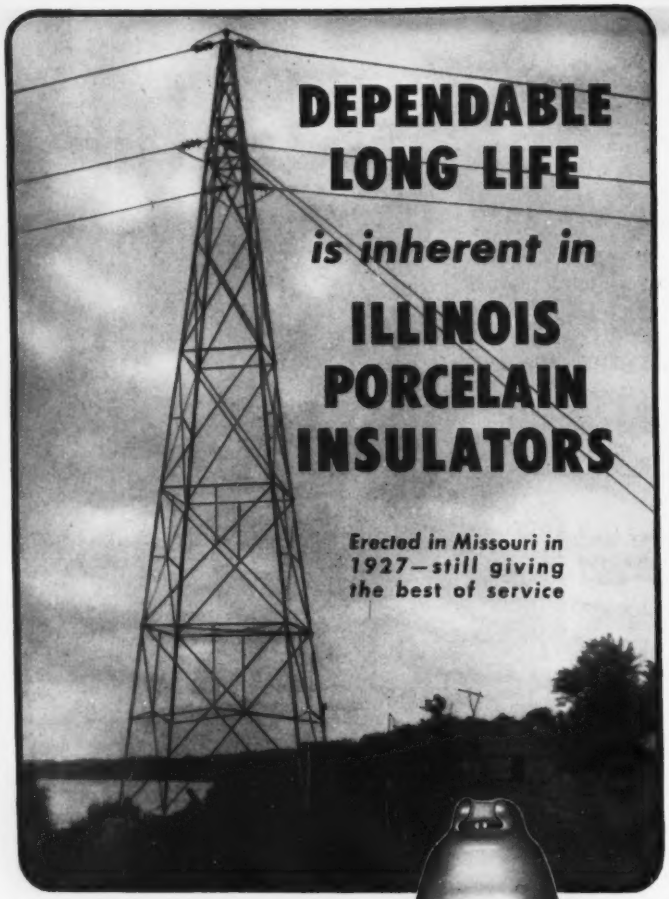
EVEN THOUGH IT'S BETTER—
TRIANGLE COSTS NO MORE!

TRIANGLE CONDUIT & CABLE CO., INC.

NEW BRUNSWICK, NEW JERSEY

IT MUST BE RIGHT

"Glazon" Building Wire • Bare Wire • Armored Cable • "Glazon" Non-Metallic Sheathed Cable • Service Entrance, Service Drop, Varnished Cambric Braided or Leaded, Thioprene Trench, Power and Parkway Cables • Rigid Conduit Hot Dipped Galvanized • Electric Metallic Thin Wall Conduit • Flexible Steel Conduit

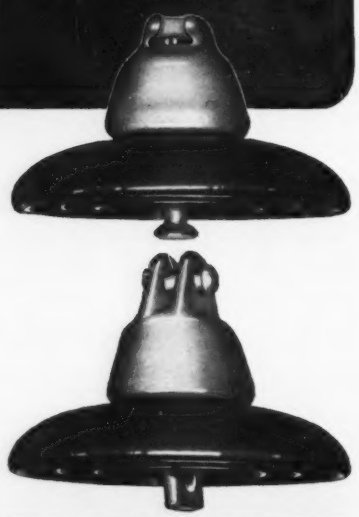


SUSPENSION TYPE INSULATORS

Produced to Illinois' exacting electrical and mechanical standards—completely tested and inspected to insure against breakdown on the job. This, plus a proved record in countless installations like the one pictured above give complete assurance of long years of thoroughly dependable service.

PIN TYPE INSULATORS

Low voltage, high voltage—one piece or multi-part—a complete line of pin type insulators, tested and proved, for every distribution job.



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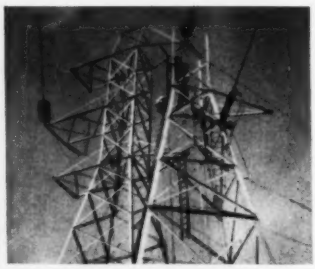
ILLINOIS
ELECTRIC PORCELAIN CO.
MACOMB, ILLINOIS

amplitudes taken before and after balancing are as follows:

Load, Mw Gear Case		Vibration amplitude, mils Initial 13 Mw	Final 12 Mw
	V	1.8	0.8
	H	2.0	0.7
#1 Brg.	V	0.2	0.5
	H	0.9	0.5
#2 Brg.	V	0.7	0.6
	H	0.3	0.3
#3 Brg.	V	0.6	0.6
	H	0.7	0.3
#4 Brg.	V	0.7	0.7
	H	0.6	0.5

These indications were regarded as signifying an unusually smooth running machine, and so vibration of mounting has been deemed negligibly small.

Cut Tower-Replacing Cost With Interlacing Scheme



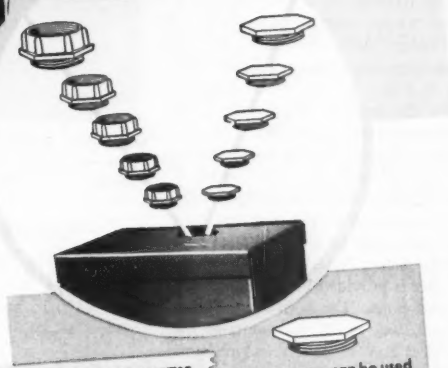
NEW TOWER (right) was placed so that top and side arm cleared old tower

G. H. BROWN
Superintendent
Line Department
The Toledo Edison Co

When a dead-end tower had to be replaced on Toledo Edison's transmission system, without interrupting service during peak load periods, the job was done by interlacing the new tower with the old. Total cost was reduced appreciably below the estimated cost of installing a temporary wood structure for the circuit during rebuilding.

The new tower was built six feet off the center of the old tower with one of the new tower legs sitting inside the rectangle formed by the base of the old tower. It was intertwined with the old tower. Several minor bracing pieces were temporarily omitted where members of the old tower interfered. The new tower was oriented so that its top section and side arms cleared the old structure. Deenergized while being worked on, the line was reenergized to carry evening peak. Old tower was removed after wires were transferred to new positions.

Square D Raintight Enclosures with INTERCHANGEABLE HUBS



"Off-the-Shelf" Selection!

New Interchangeable Hubs for Square D raintight enclosures solve the problem of more flexibility in stocking and installation. Customer requirements can now be filled with "*off-the-shelf*" selection of the right hub size for any enclosure without excessive inventory.

Type RO raintight devices have extruded openings, threaded for interchangeable hubs. Any one of several sizes can be quickly screwed into place. Threaded joint eliminates need for grounding strap. When no hub is required, a closing cap can be used to seal the opening.

Type R enclosures without openings remain available for those areas where hubs are not used.

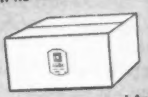
All raintight enclosures with interchangeable hubs are Underwriters' approved.

Write **for Bulletin 6100. Address: Square D Company, 6060 Rivard Street, Detroit 11, Michigan.**

NEW FLEXIBILITY

Hubs, in ¾", 1", 1¼", 1½" and 2" sizes, fit tapped openings in top endwall of Type RO raintight enclosures.

Closing caps can be used to seal off tapped opening in Type RO enclosures when no hub is required.



Closing caps and hubs are separately packaged —ten of each size or type in a carton.

ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS

SQUARE D COMPANY

DETROIT · MILWAUKEE · LOS ANGELES

SQUARE D COMPANY CANADA LTD., TORONTO • SQUARE D de MEXICO, S.A., MEXICO CITY, D.F.

Ore Unloader Saves Manpower and Time

W. B. MacLEAN
Crane & Bridge Dept.
Dravo Corporation
Pittsburgh, Pa.

A 15-ton iron ore unloader recently installed on the east coast requires only one man for operation of all its functions and features high speed and smooth operation. A supplemental 7½-ton bucket, which operates in conjunction with the turntable on the trolley to rotate the bucket, saves time during cleanup and unloading from boats with small hatches.

The unloader is carried on four 8-wheel trucks, one at each corner of the tower. All eight wheels at each corner are driven by independent 45-hp motors. A safety arrangement limits the drop of the truck to one inch in case of axle failure.

The hoist for raising and lowering the apron is on top of the tower. It is operated by a 250-hp electric motor driving through worm gear and spur gear reductions to a welded steel rope drum. Safety interlocking by limit switches is provided between the latch and the hoist. The hoist is in a sheet metal house which also contains the electrical control panels and resistors for the tower travel motors.

At each end of the runway a spring buffer is provided for emergency stopping. Speed and travel is further protected by limit switches.

The trolley is a heavy welded steel frame approximately 12 ft wide by 34 ft long. It supports a two-motor hoist for the bucket and two trolley drive mechanisms. Suspended from the trolley is a two-story all-welded sheet metal control house. The upper story houses electrical control boards and resistors for hoist and trolley travel and the lower story is the operator's cab.

The trolley drive motors are mounted on welded steel cradles fastened to two points on the axle through anti-friction bearings and to a third point on the trolley frame through a flexible connection. This allows for flexing of the supporting springs without mis-alignment of gearing. These motors are 125-hp each. At each corner of the trolley there is a safety lug to prevent the trolley from dropping more than 1 in. in case of axle failure.

NEW ORE UNLOADER at east coast port reduces turn-around time for ore boats and aids steel production utilizing foreign ores. It features one man operation with high speed and smooth performance

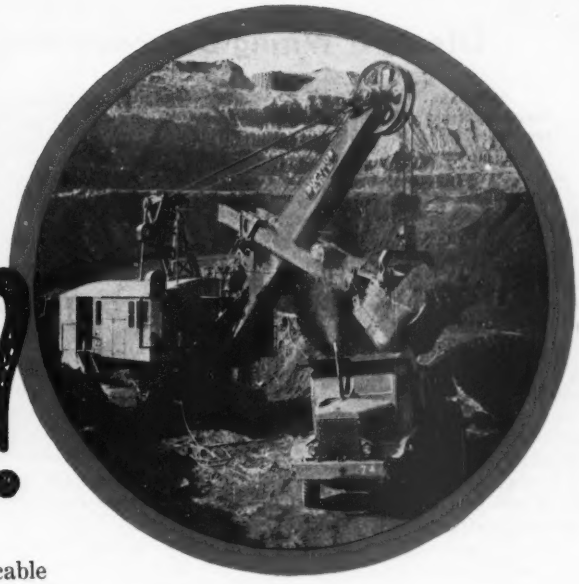
ELECTRICAL ENGINEERING IN INDUSTRY

While the main digging bucket is of 15 tons capacity, the trolley also is arranged for a 7½-ton bucket used in small hatches and clean-up work. A motor driven turntable is incorporated in the trolley frame whereby the operator may rotate the smaller bucket to suit digging conditions. This is accomplished by connecting two of the bucket ropes to the drums and dead-ending the other two on the turntable. The 250-hp hoist motors each drive a welded steel grooved drum through double reduction gearing.

The unloader is operated on 230 v dc and all control is of the full magnetic type. Limit switches prevent overtravel of bucket and trolley. The rail clamps are interlocked with drive motors and the apron hoist control is interlocked with the apron latch to prevent errors in operation. An anemometer mounted on top of the tower is arranged to shut off the tower travel motors and apply the rail clamps and motor brakes, and to set up a dynamic braking circuit whenever the wind exceeds a velocity of about 42 mph.

Design capacity of the unloader for free digging on an average cycle from ship's hold to storage pile is 1,100 net tons per hr of iron ore weighing 150 lbs per cu ft. Working with existing equipment to unload ships bringing foreign ore to the plant, the new unloader has contributed toward considerably reducing turnaround time for ore boats.

WHY TIREX?



Why is TIREX so often the cord or cable specified to serve portable electric tools and apparatus where operating conditions are severe? Why? Because cured-in-lead Simplex-TIREX Cords and Cables can't be beat for the toughness and electrical stability that are so necessary to efficient portable cord and cable performance.

In the operation pictured above, for instance, a TIREX cable is expected to, and does, deliver unfailing service to the giant shovel that's loading valuable iron deposits on the Mesabi range. The performance of the cable largely determines the shovel's output. And output must be high!

But look at the conditions under which the cable must work. It is dragged over abrasive iron ore, subjected to runovers by trucks and shovel crawlers. It is exposed to burning sun or foul weather, and to the hazards of grease and oil. Only a cable design that provides extra toughness and lasting stability of its electrical properties will carry on under punishment like that.

Such a design is standard for all TIREX products. It is your assurance of satisfaction from every investment in TIREX Portable Cords and Cables. Whether you're equipping small hand tools, heavy machinery, motors, welding or lighting units, specify and be sure that you get genuine Simplex-TIREX Cords and Cables. For complete information, write us direct or call in the Simplex representative nearest you.

Simplex

WIRES & CABLES

SIMPLEX WIRE & CABLE CO., 79 SIDNEY ST., CAMBRIDGE 39, MASS.

Effective Wiring Demonstration By 4-H Club Boys

HAROLD H. BEATY
Extension Agricultural Engineer
Iowa State College of Agriculture
Ames, Iowa

Boys from the 4-H Clubs of Iowa have built an exhibit for demonstrating the effects of inadequate wiring. They worked under the direction of the Iowa State College Agricultural Engineering Section and were assisted by farm advisors of power companies and REA co-ops in the state. Financial support is being given to the activity by the power companies. In the past three years 4,600 Iowa farm boys have participated and the activity is still growing.

Demonstrations are being put on by the boys for interested farm groups and other special gatherings.

First, a small switch box having only two circuits furnishes services to such limited needs for electricity as prevailed 15 years ago. A larger switch box with eight circuits supplies today's increased requirements for electricity.

Two sets of farm buildings are exhibited, one with poor wiring and one with adequate wiring. Switches controlling lights and appliances in each are operated to show dimming of lights on the poorly wired farmstead as contrasted with the absence of dimming when such equipment is switched on the adequately wired farmstead.

Next, using two coils of wire, one of No. 18 lamp cord and one of No. 10 rubber covered wire and each 100 ft in length, various appliances are turned on with service first over one cord and then over the other. The demonstration shows how the smaller cord heats and the lights dim when it is used for service. This is contrasted with lack of heating and absence of dimming of lights when service is over the No. 10 rubber covered wire.

Another demonstration shows how an overheated wire can cause a fire. A bare wire is connected in a circuit. When a light is turned on, the wire remains cool but as appliances, such as toasters and irons are plugged in, the wire heats up causing paper near it to catch fire.

Final demonstration shows the effect of low voltage on the starting torque of a motor. A split-phase motor is used. A chain fastened to the motor registers motor starting torque on a dairy scale. The motor is connected through the 100-ft coil of No. 18 lamp cord.

EFFECTS OF INADEQUATE WIRING on the farm are demonstrated by 4-H Club boys at the Management Conference of the Iowa Utilities Association

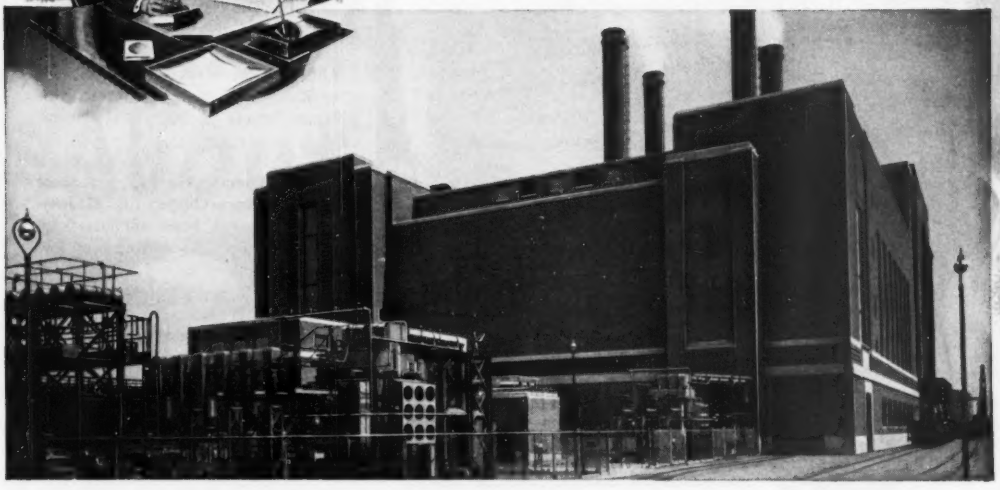
The motor is turned on and starting torque noted. The motor is then turned off and several appliances are turned on, lowering the voltage to the motor. Again, the motor is turned on and pounds pull by the motor and the voltage are noted. The boys at this point explain that the motor is rated to operate at 115 v and that 25% of its starting torque is lost if the supply voltage drops to 100 v. They also explain that 50% of the torque is lost if the supply voltage to the motor drops to 80 v. In this last demonstration the boys turn the motor on and off quickly to avoid overheating.

Planned Lighting in Utility Drafting Room

Sylvania Electric Products, Inc, photo

APPROXIMATELY 100 ft-c at table level blankets the 3,100-sq ft drafting department of the New England Electric Power Co, Boston, Mass. Room brightness is quite high and the brightness ratios in the normal field of view are favorable. High light reflection from the rooms' surfaces also add to the satisfactory seeing conditions, with the accoustical tile ceiling having a reflection factor of approximately 85%, the light buff walls 80%, and the brown linoleum floor approximately 15%

"My bet's on Bituminous—



—the kind that is mined on the B&O!"

Take a tip from executives who think in terms of fuel economy and dependability of supply. These men design their plants for the efficient coals mined in B&O territory.

These coals, available in wide variety for all needs, lend themselves to mechanized, low-cost mining. As they are located close to America's industrial heart, transportation costs are moderate. And because their sources are *known* and *definite*, they can be depended upon —*even during wartime*—for centuries to come.

Backing its faith in Bituminous, the B&O has made large capital investments in its properties. The result will be even more efficient service for the Bituminous industry and its customers.

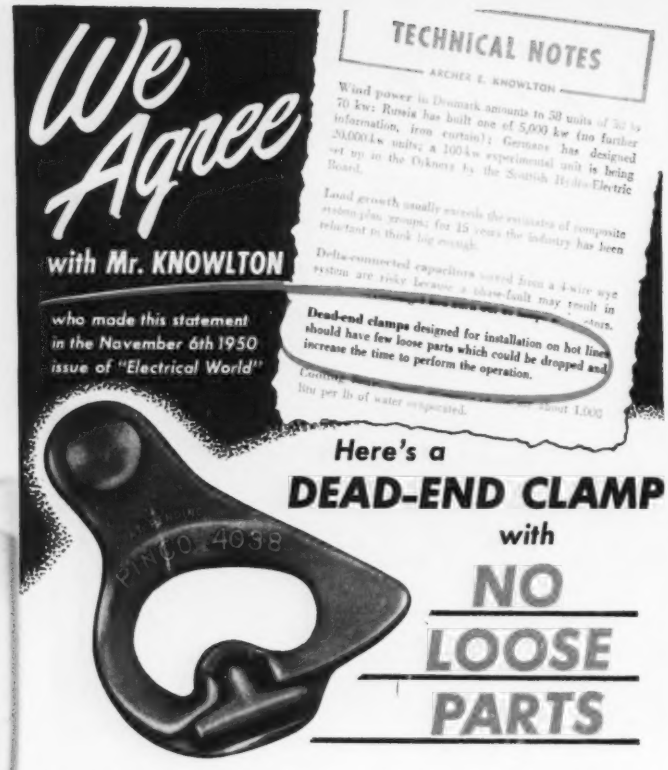
Ask Our Man!

BITUMINOUS COALS FOR EVERY PURPOSE

from modern mines like this—→

BALTIMORE & OHIO RAILROAD

Constantly *doing things*—better!


We Agree
with Mr. KNOWLTON
who made this statement in the November 6th 1950 issue of "Electrical World"
TECHNICAL NOTES
ARCHER E. KNOWLTON
Dead-end clamps designed for installation on hot lines should have few loose parts which could be dropped and increase the time to perform the operation.
Here's a
DEAD-END CLAMP
with
NO
LOOSE
PARTS
PINCO 4038

If this is news to you, then it is our fault—because this Pinco L 4038 Dead-End Clamp was introduced eleven years ago! Prior to that time, all other clamps of this type had as many as *eight loose parts* which made them extremely difficult to assemble on the job.

The Pinco L 4038 Clamp with its simplified design not only speeds up installation but shows definite improved vibration characteristics with small copperweld or stranded copper conductors—(from .16″ to .375″ diameter inclusive). Today's model is even more efficient. An *extra long* J-Bolt Keeper of improved design *doubles* the clamping area on the conductor (contacts *all* wires in the long-lay conductors) . . . holds them securely without damage.

This Pinco L 4038 Clamp is another example of sound product planning which pays off in improved performance. Remember this whenever you specify and buy insulators and line hardware.

The Porcelain Insulator Corporation
761 Main St., Lima, N. Y.

Sales Agents: JOSLYN MFG. & SUPPLY CO.
Offices in Principal Cities

PINCO INSULATORS

Suspension Insulators . . . Switch and Bus Insulators . . . Distribution Clamps . . . Distribution Pin Types and Guy Strains . . . Transmission Line Fittings . . . Tree Insulators . . . Transformer and Circuit Breaker Bushings . . . One Piece and Multi-part High Voltage Pin Types . . . Suspension and Strain Clamps . . . Indoor Bus Support Porcelain . . . Lightning Arrester Porcelain.

INDUSTRIAL BRIEFS

Extremely Low Temperatures (—65 C) are obtained by electric refrigeration in the testing laboratory of Plastoid Corp, Hamburg, N. J.—replacing the formerly-used dry ice method which could not provide temperature below —24 C. The electric system provides accuracy of temperature control of plus or minus 1 C, which was impossible with the dry ice refrigeration.—S. Burck, Industrial Engineer, New Jersey Power & Light Co, Dover, N. J.

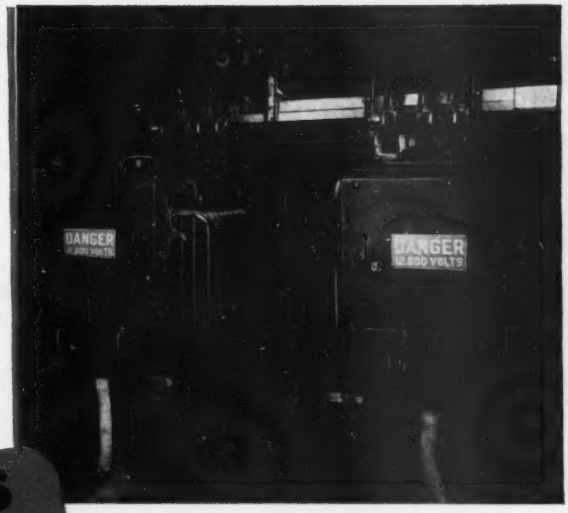
Water Contamination of transformer oil at Southern Oxygen Co, Bladensburg, Md., has been minimized by feeding surplus dry nitrogen at low pressure into tops of transformer tanks. The nitrogen is then permitted to escape through vents in tops of tanks to prevent possible buildup of excessive pressure on gaskets. Company has experienced trouble in the past with moisture. Since plant operates 24 hr daily on a 7-day week, appreciable savings are realized in labor of filtering and cost of replacing oil.—E. P. Shrewsbury, Power Engineer, Potomac Electric Power Co, Washington, D. C.

Joining Wood, Plastic and cardboard forms by dielectric heat at Adcolor Display Co, Philadelphia, Pa., saves time and assures uniform quality in hardening spot or ribbon gluing. It saves space compared with other methods used, where clamping, racking and air circulation are required. It furnishes accurately controlled heat. Dimensional displays and other specialities are assembled easily, quickly and securely without use of nails or screws. H-F generator has 1-kw output.—L. Albertson, Application Engineer, Philadelphia Electric Co.

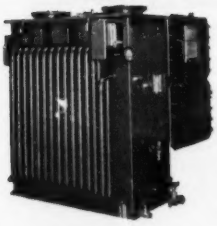
Shaling Clay and Shale with an electrically-driven shale planer has eliminated need for blasting in a populated neighborhood for the United Brick and Tile Co, Oklahoma City, Okla. Material comes out of planer sized and ready for use. With blasting and shovel operations the material must be crushed before sending it to the brick factory. Planer is powered by a 50-hp motor and operates against face of pit on a semi-circular track.

Talk to Other Engineers About

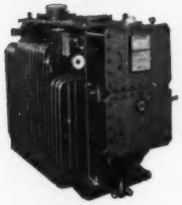
ALLIS-CHALMERS NETWORK TRANSFORMER



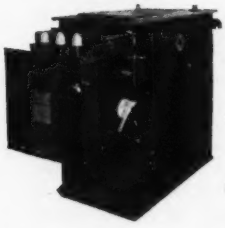
There is no finer testimonial to dependable Allis-Chalmers Network transformers than the approval of utilities and consulting firms throughout the country.



OIL FILLED. Widely used because of over all economy and proved dependability. High in efficiency and reserve thermal capacity. Vault or subway types.



CHLOREXTOL LIQUID FILLED. *Clorextol* liquid is non-inflammable. For use where safety codes require extra safety. Vault or subway types.



NEW SEALED DRY TYPE. No fire or explosion hazard. No coolant necessary thanks to Class H insulation. Core and coils hermetically sealed in an inert gas.

YOU CAN LEARN about excellent Allis-Chalmers transformer performance by talking to engineers and operators of network systems . . . men who specify and buy network transformers. Proof of top performance can be found in the steady growth of installations with the familiar A-C trademark in major electrical system coast to coast. Today over 1,000,000 kva of Allis-Chalmers Network transformers are in service . . . operating continuously and dependably, supplying economical power to homes, business and industry.

One reason for wide acceptance of A-C Network transformers is the Allis-Chalmers time-proven circular coil design. Outside core clamping bolts and highly efficient turn-to-turn insulation permit high thermal capacity, even under the most severe load conditions. Another reason is the mechanically compact assembly, sturdily built to withstand adverse conditions.

Shot blasted 3-coat baked-on paint surfaces give superior protection. Undercoating protects areas most subject to corrosion. Main cover, welded to the tank, eliminates large gasket.

Take advantage of Allis-Chalmers wide range of ratings and types. Choose the network transformer that is best for your system . . . Oil-filled, *Chlorextol* liquid filled or the New Sealed Dry-Type.

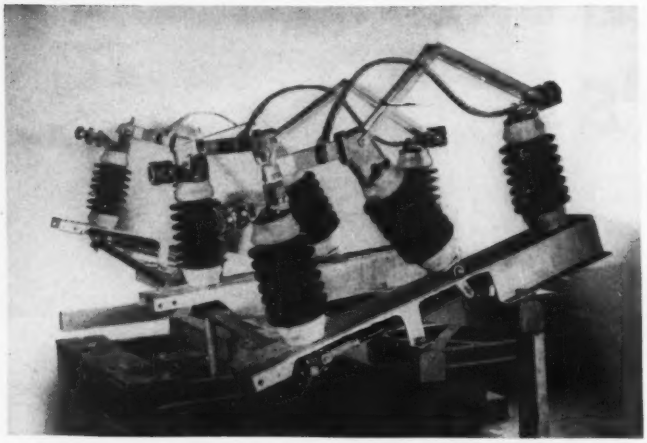
Call in an Allis-Chalmers representative early in your network planning stages for his unbiased recommendation on the best suitable type for your system. Write Allis-Chalmers, Milwaukee 1, Wisconsin for bulletin 61B6152A. A-3288

Chlorextol is an Allis-Chalmers trademark.

ALLIS-CHALMERS

Network Transformers — Over 1,000,000 KVA Installed

NEW EQUIPMENT



Insulator Switches

Ice breaking ability of the WN-VN tilting insulator switches has been increased by rearrangement of the compensator control mechanism. This control is now placed beneath the switch base where it is protected from the weather. A specially designed head makes possible a prying crow-bar action of the blade, which also contributes toward ability of the switch to open under heavy ice.

Another advantage of the compensator control is reported to be its ability to compensate for structural warpage. All three phases of the switch are claimed to close completely and make proper contact under extreme distortion of the mounting framework without adjusting the controls. The test picture above shows no changes in adjustments were made to meet a distortion of 17 deg.

The cut-away of the switch base shows the compensator control mechanism that was originally designed to prevent shock in closing the switch, simplify installation, and increase operating leverage.

Types WN and VN switches are available in voltages from 7.5 to 46 kv, 200, 400, and 600 amp.

A. B. Chance Co, Centralia, Mo.

Transformer Test Meters

Complete information on the loading of distribution transformers may be obtained with the Com-Test set, manufacturer states. Meter equipment furnished with the set consists of two thermal-type ampere demand meters and one thermal-type minimum-maximum voltmeter. The ampere demand meters are connected in each side of the three-wire circuit, while the voltmeter is connected across the line.

The following information may be secured:

1. Ampere demand, so that thermal effect of load on the transformer can be learned.

2. Balance of loading between the two sides of a three-wire service.

3. Minimum and maximum voltage across the service wires. Ten-minute average of low and high voltage is indicated.

The Com-Test is an assembly of four sockets closely nippled together. In addition to the three meters mentioned, one of the sockets has a back plate with bayonet terminals to plug into the customer's socket. By replacing the ampere demand meter, transformers from 3 kw to 15 kw may be tested.

Electric Meter Laboratory, 12th & Richmond Sts, Mattoon, Ill.

•

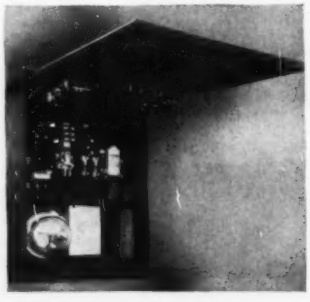
12-Channel Carrier

Facilities for superimposing up to 12 channels in the frequency range from 36 to 150 kc on circuits already equipped with carrier to about 30 kc are provided by Type 42C Carrier. Twenty-four dialing or telegraph sub-channels can be superimposed on one voice channel.

The single-link channel bandwidth of 150 to 3,600 cps is maintained at 200 to 3,400 cps when five links are operated in tandem. Pilot-frequency automatic-gain-regulating equipment is provided for both terminals and repeaters. This compensates for attenuation variations on the line circuits mainly due to weather.

Lenkurt Electric Co, 1105 County Rd, San Carlos, Cal.

•



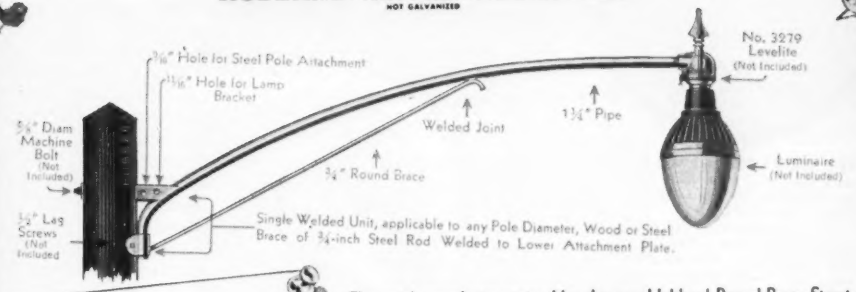
Motor Starter

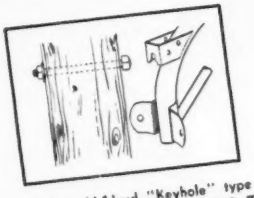
Designed for application with a single-speed squirrel-cage motor used in oil well pumping, combination Life-Linestarter of Class 11-206-OP starts, stops, and provides the motor with overload, low voltage, short circuit, and lightning protection. The enclosure permits inclusion of optical accessories such as the day-omission feature that allows programming of a week's pumping, and the time-delay

THE POPULAR NEW STREET LIGHTING BRACKET

HUBBARD ROUND BRACE TYPE

NOT GALVANIZED


No. 3279 Levelite (Not Included)
13/16" Hole for Steel Pole Attachment
13/16" Hole for Lamp Bracket
5/8" Diam Machine Bolt (Not Included)
1/2" Leg Screws (Not Included)
Welded Joint
1 1/4" Pipe
3/4" Round Brace
Luminaire (Not Included)
Single Welded Unit, applicable to any Pole Diameter, Wood or Steel
Brace of 3/4-inch Steel Rod Welded to Lower Attachment Plate.

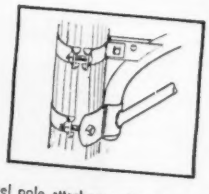


The exclusive Hubbard "Keyhole" type of attachment permits installation by one man. Insert the Machine Bolt in the pole and turn nut down so that the head of the bolt is left projecting about an inch from the pole. Simply "hang" the Bracket over the head of the bolt. Then draw nut tight and install the lags in the bottom plate.

The quick popularity attained by the new Hubbard Round Brace Street Lighting Brackets is easily understood. They have a smooth upsweeping curve that combines appealing grace with practical features of high lift and easy wiring.

Mounting space on the pole, between mounting bolt and lag screws, is only 8⅜-inches, and the actual gross measurement from top to bottom of attachment is less than one foot. This extreme economy of space becomes a most desirable feature where small space is available, or where it is necessary to mount the bracket at the top of the pole to gain luminaire elevation. Attachment plates, ¾-inch round brace, and pipe are welded into one integral unit of great rigidity and strength.

The bracket may be mounted on steel poles . . . simply specify pole diameter, bands and bolts for this purpose. It is furnished with threaded end for Levelite attachment or plain end for slip-fitter luminaires.



For steel pole attachment, there is no change in the design of the arm. Bands are used, constructed to attach to the top fastening of the arm and utilizing two angle bolts to attach to the bottom fastening. For small diameter pole mountings, the "ears" on the lower attachment are drawn in by tightening the nuts until the best fit is obtained.

Stock No.	End	Nominal Length, Feet	Nominal Pipe Size, Inches	Rise—From Top of Lower Attachment Plate to Center of Pipe at Outer End—Approx. Inches	Approx. Shipping Weight Lbs., 100 Pcs.
23206	Threaded	6	1¼	26	3150
23206-P	Plain	6	1¼	26	3150
23208	Threaded	8	1¼	29	3500
23208-P	Plain	8	1¼	29	3500

HUBBARD AND COMPANY

ESTABLISHED 1843

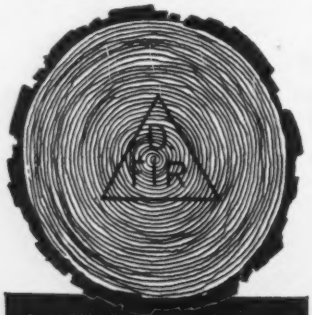
PITTSBURGH • CHICAGO • OAKLAND, CALIFORNIA

"Hang the Load on Hubbard Hardware!"

FOR LONG LIFE and low service cost, the big 3 in western poles are Western Larch — Lodgepole Pine — Douglas Fir.

All 3 are grown on the virgin forest lands of the J. Neils Lumber Company in western Montana. All 3 are produced and treated in J. Neils modern pole plant at Libby, Montana.

J. Neils Lumber Company, since 1895 a quality manufacturer of forest products, invites your inquiry on transmission and telephone poles. An illustrated folder on J. Neils treated poles, and information regarding their application to your own requirements, will be furnished on request.



relay for staggered automatic restarting after power failure.

New components include the starter, a 3-pole, 650-v lightning arrester, and a slamproof self-indicating handle. In NEMA sizes 1 through 4 as either a local control unit or automatic unit, the starter is made in ratings up to 100 hp, 440 v, 3-phase. Mechanically-interlocked dead-front inner door protects the operator.

Westinghouse Electric Corp, P. O. Box 2099, Pittsburgh 30, Pa.

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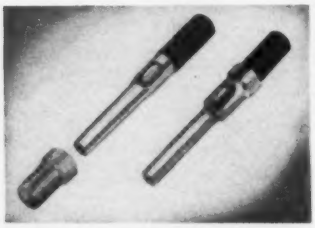

Meter Entrance Plug

Entrance cable can be brought into watthour meters with the Hyplug, an indent-type plug. The cable is indented to the Hyplug with a standard Hytool or Hypress. Slipping a nylon sleeve over the barrel insulates the assembly.

Available for any combination of meter openings and cable sizes, this plug eliminates the need for solder and reportedly provides a low-resistance joint. Nylon insulating sleeves are available for most cable sizes.

Burndy Engineering Co, Inc, 111 Bruckner Blvd, New York 54, N. Y.

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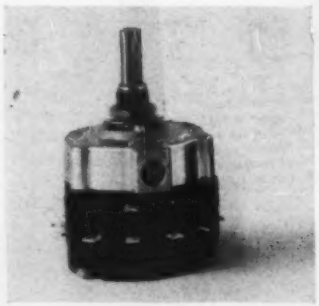


Selector Switch

For use in instrument circuits is a new rotary selector switch with solid silver contacts and totally enclosed construction. Contact resistance is about 0.001 ohm, and changes less than 0.0005 ohm on life tests of 10 million operations, manufacturer reports.

Brushes are multiple-leaf, self-aligning, made of durable silver alloy. Switch is a shorting type, and is designed for two-hole panel mounting. Various switching combinations are supplied, from single-pole 12-position to 6-pole 12-position.

Current interrupting capacity is one amp at 110 v, 60 cycles on resistance load. Maximum inductance is under 0.03 microhenry; capacitance between segments is less than 0.5 μμf. Insulation withstands 500 v rms between segments and from segments to ground.

Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia 44, Pa.

•

Low-Voltage Test Light

The Lo-Volt Test Lite Model 1300 can be used for 3 to 25 v ac or dc, for low-voltage controls such as thermostats. It may be used with a battery supply to test for continuity. A second model, No. 1310, covers the range from 6 to 50 v ac or dc. It is encased in a plastic housing, and has flexible leads with coverings 10 in. long. The leads are terminated in spring clips.

Industrial Devices, Inc, Edgewater, N. J.

•

NAIL STRAPS—One-piece malleable iron nail straps are available for armored cable, non-metallic cables, rigid conduit, and E.M.T. They are useful for other strapping purposes, such as service entrance cable. Only a hammer is needed to install them.

Gedney Electric Co, RKO Bldg, Radio City, New York 20, N. Y.

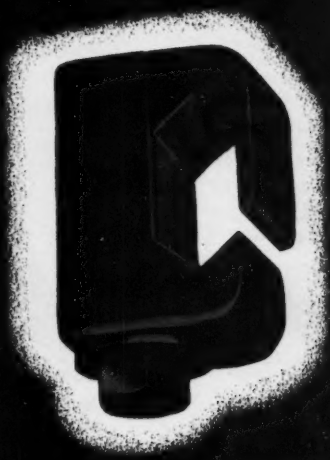
•

DC Power Supplies

Selenium rectifier stacks are utilized in a new line of standard, metal-enclosed dc power supplies. This equipment can be used for excitation of synchronous motors, operation of dc

Unsurpassed for

High Conductivity
Ease of Installation
Safety
Overall Economy



FARGO CONNECTORS

Fargo Connectors *grip like a vise* to give an ideal . . . vibration-proof contact — high in conductivity . . . with high compression at low wrench torque. They are easy and safe to handle . . . require no attention after installation — and can be used over and over again. Ask your Line Material Sales Engineer to give you the complete details on these, as well as the other time and labor saving devices in the Fargo line.

*Approved by Underwriters' Laboratories, Inc.

. . . "built like a vise — grip like a vise."

FARGO

Manufactured by
FARGO MFG. COMPANY, INC.
Poughkeepsie, N.Y.

Distributed by
LINE MATERIAL COMPANY
(A McGraw Electric Company Division)
Milwaukee, Wisconsin

LM

KPF POLE TOP SWITCHES

Simple design
means economical installation

Bore two holes in a single crossarm, tighten two bolts, attach the conductors, and the switch is installed! No separate dead-ends, no "extra" insulators required. Saves man hours, saves installation costs.

Simple design also means lower first cost, less maintenance. Insulator stacks are readily adjustable for line sag. Free-floating, self-aligning, silver-surfaced blades and jaws maintain proper contact under all conditions of sag adjustment. Switches can be used in vertical, horizontal or triangular mountings. The low-cost, trouble-free service rendered by KPF switches is attested by the many thousands in use throughout the world.

KPF ELECTRIC COMPANY
857 Howard Street • San Francisco 3, Calif.

elevators and machine tools, and for conversion of ac feeders to dc.

Either 125 or 250 v dc can be supplied from a 208-, 230-, or 460-v, 3-phase, 60-cycle ac supply. Convection-cooled equipment is available in ratings from 0.75 to 5 kw; fan-cooled units are rated at 7.5 to 25 kw. Efficiency runs as high as 81 to 84% when power factor is 95%. Two or more units may be connected in series or in parallel.

General Electric Co, Apparatus Dept, Schenectady 5, N. Y.

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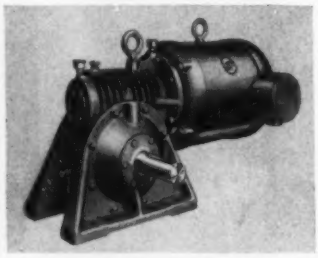

GEAR-MOTORS—A new line of ventilated integral horsepower gear-motors is available in 1 hp and smaller ratings single-phase. Polyphase and dc motors may be had through 7½ hp.
Janette Mfg Co, 558 W. Monroe St, Chicago 6, Ill.

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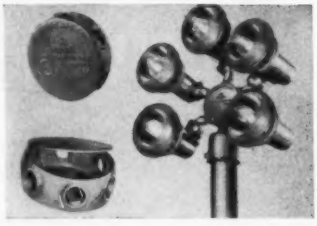

Outdoor Floodlights

Weatherproof cluster lights designated Stonco Cluster Box No. 25 fill outdoor protective lighting, factory yard lighting, and other industrial area-floodlighting needs. Each box has six holes tapped ½-in. IPS to take from one to five standard lampholders for the 150-w, 200-w, and 300-w outdoor weatherproof reflector bulbs.

Die-cast aluminum alloys are used in the unit. A removable cast aluminum cover plate sealed with cork gasket provides quick access to inside wiring and speeds up installation. Accessories available include slip fitters

Quinterra, type 6, being used as interlayer insulation in a Marcus distribution transformer.

MARCUS TRANSFORMER CO., Inc.

MANUFACTURERS AND DESIGNERS OF STANDARD AND SPECIAL TRANSFORMERS

32-34 MONTGOMERY STREET — HILLSIDE 5, NEW JERSEY

Mr. B. B. Woodford
Johns-Manville Sales Corporation
22 East 40th Street
New York 16, New York

Dear Mr. Woodford:-

Now that we have been using Quinterra electrical insulation for over a year, we believe you will be interested in our experience with it. During this period, we have produced over 10,000 air cooled transformers, ranging in sizes from 1 KVA to 2000 KVA with voltages to 13,800 volts.

When Quinterra was first introduced we became interested. We felt its high temperature dielectric properties and uniform smooth texture would permit us to produce long lasting transformers with better space factor as to insulation thickness. Our beliefs have been completely confirmed. Rejection of completed units under our own severe tests have been practically eliminated. Products are running more uniform in size. Production has increased. Complaints from the field involving Quinterra insulated transformers are negligible compared to what was considered normal previously.

Our use of Quinterra consists primarily of layer insulation and a small amount for our taps and as wrapper and ground insulation. Compared with insulations previously used for these applications, besides getting a far superior product, we found a material saving in our costs. This saving has run as much as 20% for the insulation required in certain transformer sizes.

We believe Johns-Manville has made a vital contribution to the life and safety of electrical devices through its development of Quinterra.

Very truly yours,
MARCUS TRANSFORMER COMPANY, INC.
Alvin Marcus
President

AMrcus

NEMA

Can you match these *Quinterra* savings in transformer production?

THIS LETTER from Marcus Transformer Co., Inc. tells about both production and use advantages of Quinterra . . . the revolutionary new purified asbestos, high temperature electrical insulation.

—And it tells about actual savings and customer satisfaction in typical operations with this flexible, continuous sheet insulation. Quinterra is being widely used for interlayer and wrapper insulation in transformers and coils. Its lasting dielectric strength assures a greater safety factor and longer operating life. Quinterra withstands higher temperatures than the hot-spot limit of 130C for Class B insulations.

QUINTERRA

- ✓ **cuts factory rejects**
- ✓ **reduces complaints**
- ✓ **improves production rate**
- ✓ **produces more uniform product**
- ✓ **cuts costs of operations**

Johns-Manville ELECTRICAL INSULATIONS

Johns-Manville
Box 290, New York 16, N. Y.

Kindly send me a copy of
Johns-Manville Quinterra Electrical Insulation EL-34A.

Name_____

Company_____ Position_____

Address_____

City_____ State_____

EW-2

FIND POWER LINE RADIO NOISE SOURCES QUICKLY

with the

SPRAGUE INTERFERENCE LOCATOR

- The ideal, portable instrument for fast, easy location of radio noise sources on power lines and electrical equipment.
- Compact, rugged, easy to operate.
- Utilizes 8-tube superheterodyne circuit. Frequency range from 550 kc to 30 mc.
- Operates from self-contained dry batteries, automobile battery, or 115 volt mains.
- Features include loop and collapsible rod antennas, built-in loudspeaker, built-in dual range output and battery test meter, calibrated r-f and audio gain controls, and beat frequency oscillator.

Write for Bulletin PF-601

SPRAGUE ELECTRIC COMPANY
North Adams, Mass.

for pipe mounting and brackets for wall mounting. Mounting to ½-in. conduit is made without accessories.

Stone Mfg Co, 489 Henry St, Elizabeth 4, N. J.

•

Insulation Resin

Outstanding electrical and physical properties are attributed by the manufacturer to Geon 404, a polyvinyl resin which can be applied in the field of wire and cable insulation. Company claims that rigid vinyl insulation based on this plastic has electrical properties superior to, and unattainable with, plasticized polyvinyl chloride.

Electrical properties listed below indicate such uses as weatherproof line wire, radio hook-up wire, navy cable and coaxial cable jackets, and primary insulation on military field wire and aircraft wiring.

Insulation Properties	Geon 404
Resistance, 1,000 ft @ 50 C, 3/32-in. wall, megohms	20,000-35,000
Dielectric strength, @ 25 C in water, v per mil	
1/64-in. wall	1,200-1,300
3/32-in. wall	800-1,000
Power factor, 1,000 cycles @ 25 C	0.015-0.02
Dielectric constant, 1,000 cycles @ 25 C	3.0-3.2
Loss factor, 1,000 cycles @ 25 C	0.045-0.064

Sheets, rods, and tubing of various diameters can be fabricated. Tanks for corrosives can be made from it. During the national emergency this new resin will be available in limited quantities and only for essential applications.

B. F. Goodrich Chemical Co, 324 Rose Bldg, Cleveland 15, Ohio

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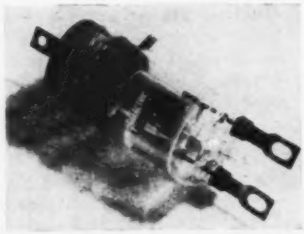

Thyratron

Because it has a commutation factor rating of 200, new GL-5855 three-electrode inert-gas-filled thyratron can be used in motor control without the need for snubber circuits or occurrence of gas clean-up. The tube, designed mainly for general control-circuit applications, has a quick-heating cathode which is said to take but a minute to reach operating temperature.

Maximum ratings include: Peak anode voltage, 1,500 v; cathode current, 150 amp, 12.5 amp average; maximum negative control-grid voltage before conduction, 250 v.

General Electric Co, Tube Divisions, Schenectady, 5, N. Y.

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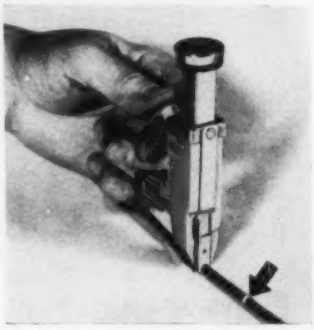


Wire Tacker

An automatic wire tacker speedily staples braided, rubber-coated, single and double strand wire and hollow tube lines. Front and rear guides circle the wire and permit rapid drawing around difficult angles or corners, along baseboards, plaster walls, ceilings, and rafters. The staples are made in several colors. They penetrate plaster or wood and have a holding power up to 64 lb.

The Heller Co, 2153-N Superior Ave, Cleveland 14, Ohio

MORE NEW PRODUCTS about which you should know

Cornell-Dubilier Electric Corp, South Plainfield, N. J., has added two new models to its line of **vibrator converters** for railroad application. Model 3248 is for 32 v dc input, delivering 115 v at 60 cycles and maximum power output of 375 va; these same ratings for Model 3212A are 12 v, 115 v at 60 cycles, 175 va. . . . Hewlett-Packard Co, 395 Page Mill Rd, Palo Alto, Cal., has designed a **signal generator,** Model 618A SHF, for microwave or super high frequencies from

Check These Features and You'll Choose VICTOR SWITCH and BUS INSULATORS

Do You Know that...

Victor maintains a modern, fully-equipped ceramic laboratory where fundamental and applied research as well as control tests on raw materials and processing are continually carried on? Small wonder Victor Insulators are famous for performance and economy!

V ALL METAL PARTS are hot-dipped galvanized to assure maximum resistance to weathering and corrosion.

V CONTROLLED TESTING and **PROCESSING** of cement assure high bond strength at all assembly joints.

V SMOOTH, HARD GLAZE assists self-cleaning process, thus reducing maintenance and replacement costs, especially in contaminated areas.

V SERVICE-TESTED DESIGN provides for maximum flash-over performance and long leakage distance.

V HIGHEST QUALITY WET PROCESS PORCELAIN—"tops" in dielectric and mechanical strength.

V RUGGED, THICK CORRUGATIONS and smooth, rounded edges give maximum resistance to impact.

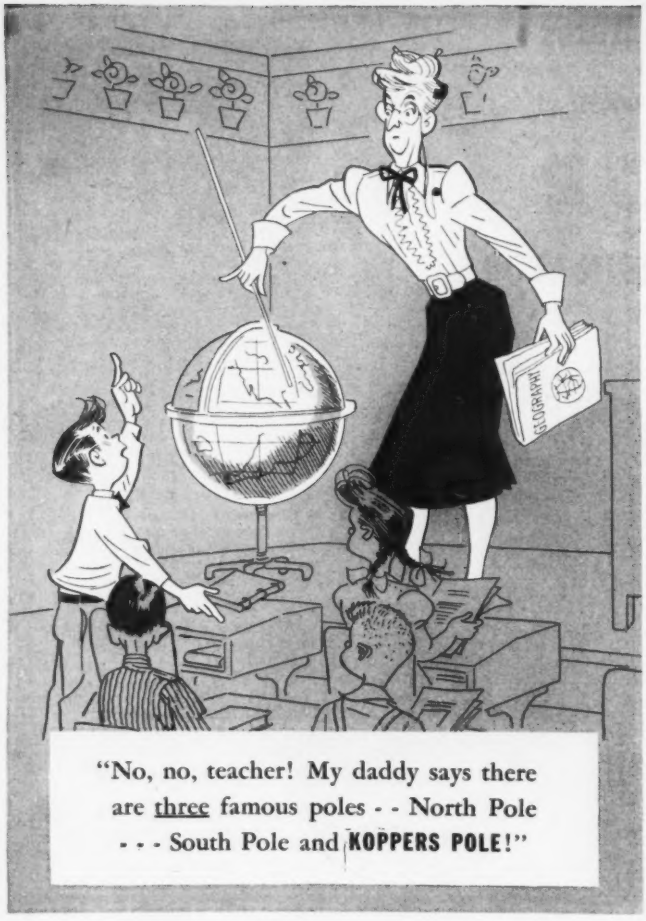
V RESILIENT COATINGS at all cemented joints give maximum resistance to thermal variations and mechanical shocks.

VICTOR NO. 742 (TR-No. 7) SWITCH and **BUS INSULATOR.** For complete engineering data on this and other sizes and types of switch and bus units, write today for Victor's complete catalog.

Specify **VICTOR SWITCH and BUS INSULATORS**

Victor Switch and Bus Insulators are preferred by power men because every component is designed to combine maximum resistance to flashover with maximum mechanical strength. To guarantee "on-the-job" dependability, each insulator is individually tested at every point of manufacture.

VICTOR INSULATORS, INC.
VICTOR, N. Y.



"No, no, teacher! My daddy says there are three famous poles - - North Pole - - - South Pole and KOPPERS POLE!"

WE don't know how the teacher is going to wangle her way out of this predicament—but we do know that, with users in the *utilities* world, the Koppers Pole *is* famous.

Line Supervisors get poles that retain their strength, and reduce maintenance work. The result is easier, more economical line operation.

Purchasing Agents like to deal with Koppers. All transactions are on a businesslike basis. Plus the fact that deliveries are dependable and the quality of the poles is uniform.

Company Officials find that Koppers Poles provide longer periods of *continuous* service, thus increasing revenue and promoting customer good will. And the exceptionally long pole life lowers annual operating costs.

KOPPERS COMPANY, INC. PITTSBURGH 19, PA.

KOPPERS PRESSURE-TREATED WOOD

3,800 on up to 7,600 megacycles.

Minneapolis-Honeywell Regulator Co, Brown Industrial Div, 2953 Fourth Ave, S, Minneapolis 8, Minn., has developed an **electronic hygrometer** for measuring and controlling industrial and commercial air conditioning. . . . The Formica Co, 4614 Spring Grove Ave, Cincinnati 32, Ohio, has developed Z-80 laminated plastic **insulating material.** It has been designed for 60-cycle applications in condensers and adaptors used in radio work.

Photoswitch, Inc, 77 Broadway, Cambridge 42, Mass., has a delayed action **photoelectric control** that detects the presence of a jam on a conveyor. It stops motion or corrects jam. . . . Leupold & Stevens Instruments, Inc, 4445 N. E. Glisan St, Portland 13, Ore., is marketing Type QAWT **wind-temperature recorder** to provide continuous, graphic records of wind speed, direction, and temperature at sites that are visited only infrequently.

International Instruments, Inc, 331 East St, New Haven 11, Conn., is producing 1½-in. VU Meter and 1½-in. Db Meter for measuring **strength of audio signals** as applied to communications equipment. . . . Tenney Engineering, Inc, 26 Avenue B, Newark 5, N. J., is offering a "packaged" variable **temperature** producing servo unit which is said to make possible air temperature accuracies of ±1 deg F.

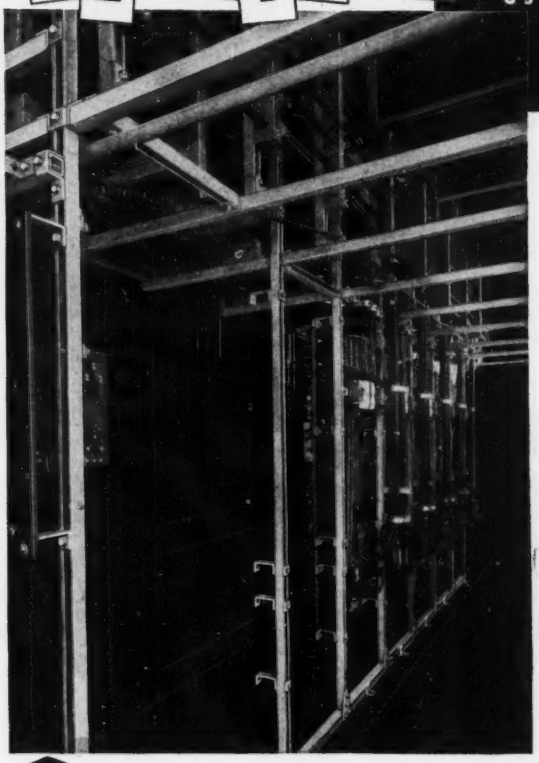
Walter Kidde & Co, 40 E. 34th St, New York 16, N. Y., is utilizing **directional valves** with its CO_2 fire extinguishing systems for protecting plants with one CO_2 cylinder bank for as many as 25 areas. . . . Ebert Electronics Corp, 185-09 Jamaica Ave, Hollis 7, L. I., N. Y., has a high power **relay** (power amplification of 10,000) of the mercury plunger type with load ratings to 35 amp and 440 v; designation is Model EM-8.

Solar Electric Corp, Warren, Pa., is manufacturing a selected line of four new **fluorescent lamps.** Two of them compensate for unnatural appearance under standard fluorescent light by including more "red" light; one is for business establishments and factories; another of the new lamps is for use in conjunction with incandescent lighting.

FLEXIBLE UNISTRUT

used in AMERICAN SUGAR REFINING COMPANY PLANT

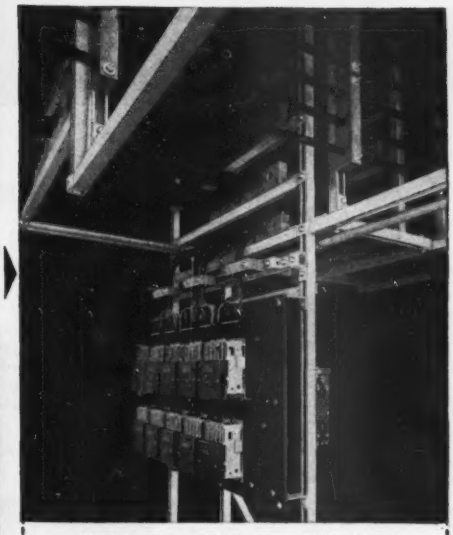
All Cable, Switchboards and Timer Control Panels Supported by Completely Adjustable Unistrut Framework



Note effective use of easily positioned maple cable clamps mounted on Unistrut channel.

These pictures show how Unistrut channel and fittings, with maple and porcelain insulators, combine to support all control equipment for the motors that operate centrifuges in one step of the sugar refining process at the Chalmette, Louisiana plant of the American Sugar Refining Company.

Unistrut permitted fast, on-the-job framing assembly where all adjustments were quickly made by merely loosening a bolt, and where supporting members were added as the work progressed. Because no drilling, welding, special tools or equipment are required to assemble Unistrut, engineering detailing and construction time were kept to a minimum. Another advantage lies in Unistrut's built-in flexibility which makes possible later changes and additions to the existing structure.



Installation is equipped throughout with Unistrut for the support of all motor control apparatus and cable.

With Unistrut you can build all types of framing, mounts, shelving, racks, tables and benches—conduit, cable, pipe and tubing hangers and supports, fluorescent fixture supports, and many other structures with just a hacksaw and a wrench. Give Unistrut a trial in your business.

Representatives and Warehouse Stocks in Principal Cities
Consult your Telephone Directories

U. S. Patent Numbers
2327587 2363382
2329815 2380379
2345650 2405631
Other patents pending

FREE CATALOG and WALL CHART!

Write for your copy of 24-page Construction Catalog No. 500, 24 x 36 Wall Chart and sample of Unistrut

The World's Most Flexible All-Purpose Metal Framing

UNISTRUT PRODUCTS COMPANY

1013 WEST WASHINGTON BLVD. • CHICAGO 7, ILLINOIS

UNISTRUT PRODUCTS COMPANY

1013 W. Washington Blvd., Chicago 7, Ill., Dept. W 2

Please send me, without obligation, the items checked below:

☐ Catalog No. 500 ☐ Wall Chart ☐ Unistrut Sample

Name_____

Company_____

Address_____

City_____ Zone_____ State_____

When the big ones use it you know IT'S GOOD!

2-Way Radio

Pepco
Matchless Service

POTOMAC ELECTRIC POWER COMPANY

Utility Speeds Service in Nation's Capital Via Mobile Radio—a General Electric Specialty

WHEN you serve 275,000 customers in the greater Washington, D. C. area, where the major industry is government . . . when your peak load jumps from 249,000 KW to 541,000 KW in 10 years for a gain of almost 120%—you build your reputation on a hard-won record of speed, service, dependability and constant improvement.

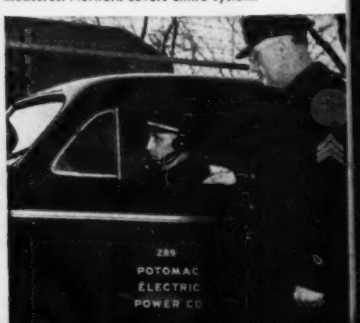
This utility, like many others, uses General Electric radio communication equipment throughout its system. The pictures tell the story—G-E 2-way radio pays for itself again and again in the conservation of manpower, materials, mileage.

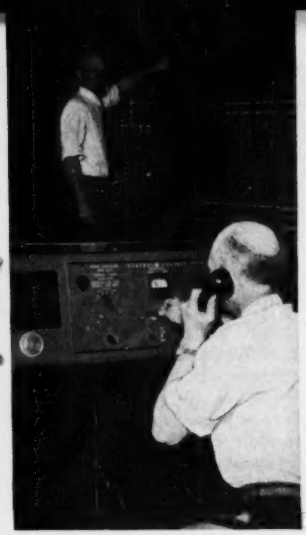
CIVIL DEFENSE—There's a way for you to tie into the emergency communication net in your community—quickly and economically. Ask the General Electric Electronics Department office near you about the Civil Defense Communications Planning Service—it can be of vital importance to your company and its customers. Why not call your G-E man today?

Day and Night All-Season Performance is outstanding feature of dependable G-E 2-way radio. FM beam rides above static, is unaffected by weather. Voice messages come in clearly.

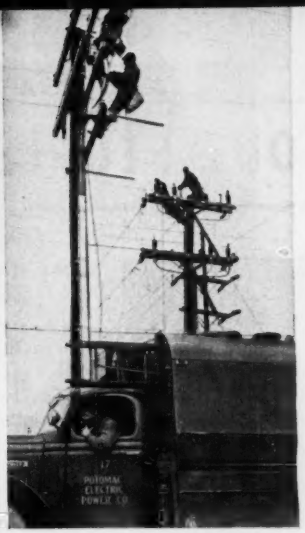
Oil and Gas-Filled Cable Maintenance Truck is an expensive, highly useful vehicle. Radio in the cab directs crews to trouble areas quickly, keeps truck on the move. Mileage records show savings due to radio communication.

Plant Sabotage Prevention keeps utility police on constant alert. Radio in police cars and alarm receivers in guard houses are extra safety measures. Network covers entire system.





Changes on Dispatching Board are made as radio calls come in at desk monitor. Scene is at main headquarters of Potomac Electric Company in Washington.



Cut-Over Establishing New Feeders into southern Maryland is carefully timed. All Pepco line trucks are equipped with radio. Note weatherproof radio box above cab.

Street Light Emergency—a routine night chore for service crew. Pole will be straightened and lamp replaced in minutes. Using G-E 2-way radio in cab, driver quickly summoned wrecker from garage.

Emergency Portable Transmitting Station can be set up anywhere, does not tie up a radio vehicle. Operator talks directly to power dispatcher and to trucks on the road, using G-E mobile transmitter.

"Phasing-Out" on 13.2 kv Circuits. Man up pole is using detector to identify phases. Crewman at truck reports to power dispatcher by radio.

Utility Claims Agent uses radio-equipped car to "get there fustest". Pepco safety engineer also has radio in his car, can get to emergency locations in minutes.

Finds Cable Faults in Minutes. Signal from G-E Thyratron cable fault finder is picked up by test truck (above). Picks on search cable down in the hole grip cable sheath. Galvanometer readings determine location of the trouble.

NEW INFORMATION KIT—FREE! Complete package of latest bulletins on G-E 2-way radio systems. Write us for your copy today. *General Electric Company, Section 1921-26, Electronics Park, Syracuse, New York.*

You can put your confidence in—

GENERAL ELECTRIC

NEWS ABOUT PEOPLE

NEW VICE PRESIDENTS of Union Electric Co of Missouri are George P. Gamble, left, superintendent of power production since 1943, and Stanley Stokes, chief engineer

Union Electric Elects Stokes, Gamble as VP's

Union Electric Co of Missouri directors have elected two new vice presidents, Stanley Stokes and George P. Gamble. Stokes has been chief engineer since 1941, and Gamble has been superintendent of power production since 1943.

Stokes' entire career has been with Union Electric. His first job in 1912 was in connection with the constructoin of the Page Avenue substation in St. Louis. Among posts he has held are assistant to the vice president, assistant to the president, and manager of outlying divisions. For about 20 years he has had general supervision of the company's construction programs. He now is in direct charge of its $400-million post-war expansion program.

Gamble started with General Electric Co at Schenectady, N. Y., in 1922 and later worked for Stone & Webster Engineering Corp in Boston. When Stone & Webster began building the Bagnell Dam project for Union Electric in 1929, Gamble was assigned to the projects. Later he became a resident electrical engineer at the dam. He joined Union Electric in 1932 on the staff of the late George K. Miltenberger, who was in charge of production and distribution until his death last March.

•

Wade H. Taylor has been appointed regional power manager at Boulder City, Nev., to supervise the technical phases of the Bureau of Reclamation's hydroelectric program in the Lower Colorado River Basin. He succeeds Roy V. Sprague, who retired last July. Taylor will be in charge of the branch of power utilization, which exercises technical supervision over the bureau's operations at Hoover, Davis, and Parker Dam power plants and their integrated transmission systems in California, Arizona, and Nevada. He started with the bureau in 1935 as a junior engineer in the technical investigations division of the chief engineer's office in Denver. In 1938 he was transferred to the electrical and mechanical division of the chief engineer's office and in 1944 to the branch of power utilization in Denver. After formation of the Region III office, he went to Boulder City in 1945 as assistant regional power manager.

Consumers Power Co Appoints Educator VP

Robert P. Briggs, vice president of the University of Michigan, has been elected vice president and director of Consumers Power Co. He will specialize in matters of finance for Consumers, which thus creates a new office in its organization.

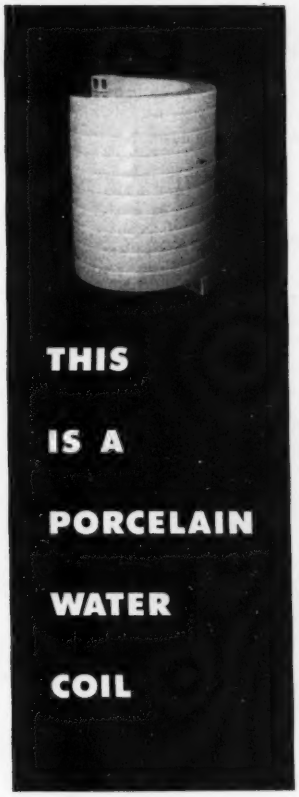
Briggs has been in charge of the university's business and finance and was instrumental in developing its current expansion program. He joined the faculty as an instructor in economics in 1927 and has been professor of accounting and vice president since 1945.

ROBERT P. BRIGGS

During World War II he was on leave from the university as chief of the general office division of the Detroit Ordnance District and was cited by the War Department for his services. Between 1939 and 1942 he served as a member of the American Institute of Accountants' Board of Economics which writes the certified public accounting examinations for most states.

•

Clarence H. LeVee has resigned as Eastern Division sales manager of the electrical wire and cable department of United States Rubber Co to become vice president and chief engineer of Fagan Electric Co, Little Rock and El Dorado, Ark. He will have charge of all engineering and construction



It is used for carrying cooling water to water-cooled vacuum tubes in radio transmission and other heavy-current electronics circuits.

You are not likely to buy such a water coil. Indeed, you may never see one. Yet if you buy or use electrical equipment which incorporates electrical porcelain, you should be interested in the skills of a porcelain-maker who can produce pieces of such critical difficulty as this.

The story goes back to 1929, when radio engineers asked for a porcelain water coil as an improvement over the rubber hose being used which introduced serious difficulties. We viewed the proposal (as would any producer of electrical porcelain) as highly impractical. Yet by 1932, our engineers had developed a satisfactory method for production of these coils. Since then, many thousands have been made, production reaching a high peak for an extremely critical World War II requirement. So far as we are aware, nowhere else in the world is this product manufactured. It requires a uniformity of clay production, a quality of clay, and an understanding of clay handling techniques achieved in few plants.

You will note that this is a twin-hole tube; the cooling water passes through the outside channel on its way to the tube, absorbs the excess heat, and passes back through the inside channel to the cooling and recirculating pumps. The porcelain is produced by extrusion through dies and "wound" on a cylindrical form. A single coil, after firing, may be as much as 35 ft. long. The coil is glazed inside and out, and during firing, the glaze seals the turns together to form a single rigid piece.

We have a large measure of pride in the accomplishment of production of these coils. It is an accomplishment made possible by skills, techniques and controls which are available to you in porcelain of highest quality for your system. In high-voltage insulators. In porcelain on other equipment. Look for the name LAPP on porcelain for your system. It's a guarantee of sound mechanical and electrical performance, of long life, of low upkeep. Lapp Insulator Co., Inc., LeRoy, N.Y.

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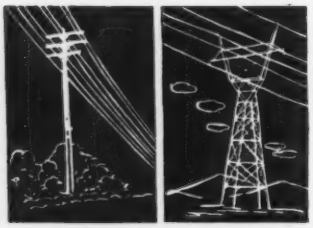
ELIMINATE RE-TIGHTENING OF NUTS

On Steel Tower and Wood Pole Lines



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activities of the company and will serve on the board of directors. LeVee spent 16 years in the utility business before joining Ford, Bacon & Davis and then Fagan Electric. He went to U. S. Rubber after World War II naval service.

•

Johnson Chief Engineer of Omaha Power District

Albert G. Johnson, assistant chief engineer of Omaha Public Power District, has been made chief engineer.

He started work with the utility in 1928 serving as field engineer, construction engineer, and underground engineer.

A. G. JOHNSON

Johnson is a member of the Nebraska Engineering Society, the American Institute of Electrical Engineers, and the Engineers Club.

•

General Electric Fills Engineering, Sales Posts

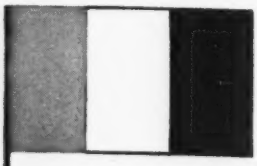
A number of engineering and sales appointments have been made by General Electric Co.

Ab Martin has been named manager of the Fort Wayne (Ind.) Works of the Apparatus Department. He succeeds C. H. Matson, made manufacturing consultant of the Small Apparatus Divisions staff with assigned duties on manufacturing administrative activities. New manager of the Oakland, Calif., wire and cable plant is Walter J. Delehanty.

P. L. Alger has been appointed consulting engineer to the Small and Medium Motor Divisions of the Apparatus Department. New appointments in the General Physics Divisions of the Research Laboratory include Dr Ferd E. Williams as head of the

paris international trade fair

FOUNDED 1904



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A. UNITED STATES RUBBER COMPANY.

Q. *What ONE wire and cable producer makes plastics?*

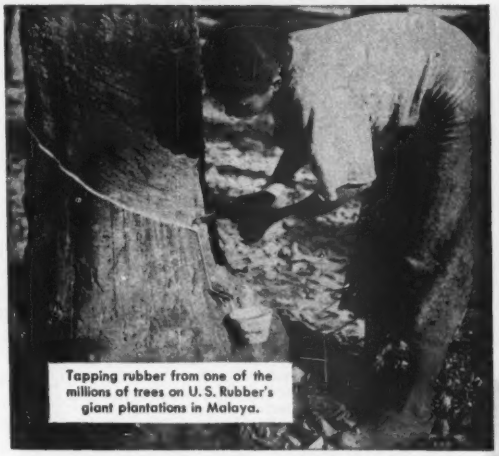
A. "U. S."

Q. *What is the most important part of wire and cable?*

A. The insulation.

Q. *Who is best equipped to make wire and cable with superior insulation?*

A. U. S. RUBBER—which grows its own natural rubber, makes its own synthetic rubber, manufactures its own plastics.



Tapping rubber from one of the millions of trees on U. S. Rubber's giant plantations in Malaya.

Isn't it logical that a rubber company should make the best wire and cable insulation there is? U. S. Rubber has been a pioneer in insulation for over 70 years—has amassed in that time a stockpile of research data and experience that can't be beat. Electrical insulation is a "U. S." specialty!

Electrical insulation makes the difference between superior and ordinary wire and cable. Conductors of all manufacturers are standard, but insulation must be the best that science can produce. That's why your best bet in wire and cable is U. S. Rubber.

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UTILITIES: Power Cables • Street Lighting • Royal Cords • Network Cables • Utility Control • Pole & Bracket Cable • Service Entrance • Weatherproof • Zip Cord Pole Fixture Cable • Sup. Control

RAILROADS: Power Cables • Communications • Railway Signal • Royal Cords • Welding Cable • Railway Utility • Sup. Control • Weatherproof

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U. S. RUBBER'S BUTYL-INSULATED POWER CABLES

These cables are for use on power distribution, street lighting and station control circuits and for general-purpose wiring on circuits up to 8000 volts between phases and at conductor temperatures up to 80 C. The insulation will not crack after four hours in air containing 0.015 per cent ozone. They are light in weight, easy to install and join, and are resistant to oil, heat, sunlight, flame, acids, alkalies and corrosive chemicals. The following are guaranteed test values:

PHYSICAL AND AGING PROPERTIES (MINIMUM VALUES)

	Butyl Insulation			Neoprene Jacket	
	Unaged	After 168 Hrs. in O.B. at 80 C.	After 7 Days in Air Oven at 250 F.	Unaged	After 96 Hrs. in O.B. at 70 C.
Tensile, lbs. per sq. in.	600	500	400	1800	1600
Elongation, per cent	400	350	350	300	250

MOISTURE RESISTANCE (MAXIMUM VALUES)

a. Dielectric constant and power factor of insulation after immersion in water at 50 C.

Dielectric constant, one day	4.0
Per cent gain, 1 to 14 days	2.0
Per cent gain, 7 to 14 days	1.0
Power factor, one day, per cent	2.0

b. Mgs. per sq. in., 7 days at 70 C. 15.0

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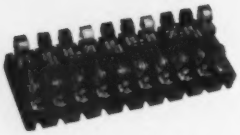

- No live parts extend beyond base. Eliminates any chance for Tester to touch "hot" terminals with fingers, tools or when replacing metal covers. An important safety feature.
- NICKEL plated, non-corrosive finish.
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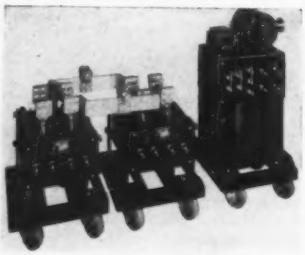

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Light Production Division and Dr Leroy W. Apker as head of the new Semi-Conductors Division. David T. Meskill has been made sales manager of the Fan Division of the Appliance and Merchandise Department.

Martin has been with GE since 1929. Among jobs he has held have been those of foreman of the test course at Pittsfield, Mass.; works accountant and assistant manager of the Bloomfield, N. J., Works; supervisor of personnel and community relations in the manufacturing division; and assistant to the manager of the department's Employee and Community Relations Division. He was named assistant manager of the Oakland, Calif., Works in 1948 and became manager a year later. Since September, 1950, he has been assistant manager at Fort Wayne.

Matson started with GE in 1909 as a draftsman at Fort Wayne. There he has served as plant engineer, superintendent of building and maintenance, general plant superintendent, assistant works manager, and since 1947 manager.

Delehanty, a GE employee for 40 years, has served as manager of the Sacramento office for the Apparatus Department, cable specialist in the San Francisco office, sales manager for the Oakland plant, and most recently local manager of the San Francisco office of the construction materials department. Alger has been a staff assistant to the manager of engineering and has been acting as consulting engineer since 1920. He is a former director of the American Institute of Electrical Engineers.

Williams taught chemistry at the University of North Carolina and served as consultant to the GE Research Laboratory before joining the lab in 1948 as research associate. He became acting head of the Light Production Division in 1949. Apker went to the laboratory in 1941 as a research associate. Meskill joined the company in 1939 and was in accounting and sales work before World War II. Since 1946 he has been a district appliance sales representative at Boston.

•

Charles Eisler, president of Eisler Engineering Co, Newark, N. J., has received an honorary doctor of science degree from Bloomfield College and Seminary, Bloomfield, N. J. Eisler founded his company in 1920. Before

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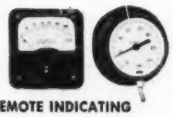

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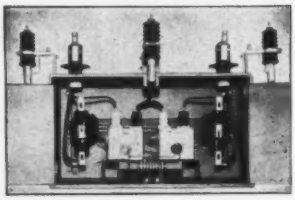

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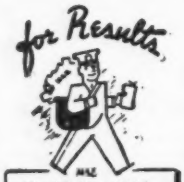

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that he was chief engineer of equipment with the Bloomfield Division of Westinghouse Electric Corp, where he designed and built the first universal coil winding machines in the United States. He holds more than 50 patents.

Thomas M. Kelliher has been appointed superintendent of power for Worcester County (Mass.) Electric Co. He succeeds **E. H. Perry,** retained as consulting engineer. Kelliher began his utility career in 1914 as watch engineer at the Webster steam plant of the then Webster & Southbridge (Mass.) Gas & Electric Co. In 1916 he was transferred to Worcester as watch engineer at the Webster Street station of the then Worcester Electric Light Co, and in 1921 he became chief engineer. Perry started with the old Worcester Electric Light Co 40 years ago as an oiler at its Faraday Street engine-driven station. Later he became watch engineer at the Millbury station of Worcester Consolidated Street Railway, watch engineer at Worcester Electric Light's Webster Street plant, chief engineer, and then superintendent of power.

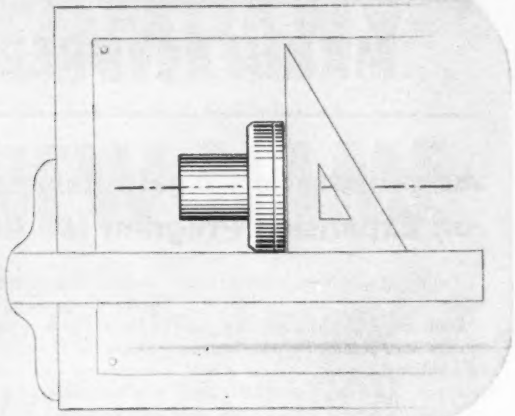
Alfred Paul has been appointed chief engineer of the Biddeford steam plant of Central Maine Power Co. He succeeds **A. Staples,** who has retired. He joined Pepperell Manufacturing Co's steam plant staff in 1927 and when that station was acquired by CMP's predecessor in lower Maine, Cumberland County Power & Light Co, in 1930 became a utility employee.

Rufus M. Bondurant, distribution engineer in the engineering department of the Bluefield, Va., district of Appalachian Electric Power Co, has been transferred to the Abingdon district as district engineer. He has been with the company since 1938.

OBITUARY

Roger S. Ruffin, 61, engineer in charge of the lands division of San Diego (Calif.) Gas & Electric Co's engineering department, died Jan. 29. He was a civil engineer and surveyor for the federal government in Arizona before joining the utility in 1916. Ruffin pioneered in laying of early gas and pipe lines in northern San Diego County.

Value Beyond Expectation!



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Fine and coin silver, while having desirable properties for many applications, do not provide the physical properties required for some applications. To cover these applications, Mallory has developed a series of silver base alloys. These alloys have such improved characteristics as greater resistance to wear, less sticking or metal transfer, and greater hardness. Mallory is fully qualified to recommend the best contact material for your design. Write today.

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MANUFACTURERS and MARKETS

Administration Again Raises Sights on Expansion Program for Aluminum

The lid on aluminum is being raised again.

Until recently Adminstration mobilizers were pushing for 446,000 tons of additional capacity—about a 60% increase. Now another 500,000 tons of capacity will be added. This will bring capacity to around 2.3 million tons a year. The industry's 1950 output was 720,000 tons.

Hearing Explores All Phases

That's the cream that came to the top during a three-week hearing into all phases of the aluminum problem by the House Anti-Monopoly Committee under Chairman Emanuel Celler.

Early in the hearings Director James Boyd, Defense Minerals Administration, stated that military estimates at that time required no more than the "first phase" of the two-step, 1-million-ton total expansion projected last fall by W. Stuart Symington, chairman of the National Security Resources Board.

Celler Backs U. S. Producers

Celler, reflecting the fear of American independent producers that the Administration was leaning toward a deal with Aluminum Co of Canada, had been plugging away at the government to make sure that the first phase's 446,000 tons actually got built in the United States. Alcan, world's biggest and lowest-cost producer, had offered the U. S. aluminum from a new low-cost facility it is ready to construct near Kitimat, B. C. In exchange it wanted a long-term purchase contract, plus assurance of some of the materials and components needed for the plant. So far no deal has been made with Alcan.

But at the hearings Secretary of Commerce Sawyer — having full knowledge of the new Munitions Board estimates on aluminum needs—told the committee, "Demand, both civilian and military, for aluminum will far exceed any presently available supply, even including everything which the Canadians as well as the Americans can supply. . . My opinion, in brief is that we should get all the aluminum we can, as cheaply as we can, and from wherever we can."

Sawyer outlined Alcan's offer of aluminum for the next five years from new facilities being built in Quebec and the first stage of the projected British Columbia installation. Deliveries to the U. S. would be 110,000 tons in 1951, 140,000 in 1952, 350,000 in 1953, 530,000 in 1954, and 680,000 in 1955.

Low Cost Power Is Key

Economically, the key to low-cost aluminum is low-cost power. Alcan is the world's and Alcoa this country's lowest-cost aluminum producer. New domestic power installations will be more expensive—2 to 3¢ a lb more with Ohio coal or Gulf Coast natural gas as fuel.

Politically, it's a U. S. government problem. Alcan won't go ahead in British Columbia without an American contract. U. S. producers too need government help. Should the Administration encourage expansion of a low-cost foreign source that conceivably could outcompete U. S. producers? Or should it subsidize high-cost capacity at home—capacity that will be available earlier and whose output the U. S. will control completely? Or both?

Present Expansion Confused

Even the 446,000-ton expansion now being negotiated is all fouled up.

All along, the deals have been based on the government's permitting five-year amortization of 100% of the costs of the new facilities. But when Kaiser Aluminum & Chemical Corp got ready to close its first agreement, it learned Defense Mobilizer Wilson had decided to limit its quick tax write-offs to 80% of the costs of expansion.

Kaiser and Alcoa may be able to go ahead on this basis. But Reynolds Metals Co claims it is stopped cold, and such a ruling undoubtedly would freeze out the two newcomers, Apex Smelting Co and Harvey Machine Co. However, the government may make an exception of the two smaller companies, figuring the "Big Three" got their breaks by buying at low cost government plants built during World War II.

Despite expansion plans the forecast is for progressively shorter supplies as far ahead as anyone can see. Interior's Defense Electric Power Administration predicts a 1951 shortage of 245,000 tons. By mid-1952 the overall discrepancy will be 600,000 tons with worse to come. Many fabricators will have to go out of business. The aluminum cutbacks already ordered by the National Production Authority are just the beginning.

•

Westinghouse Selects Alabama for Lamp Plant

Westinghouse Electric Corp has bought a 70-acre tract in western Alabama for construction of a light bulb plant, first Westinghouse consumer product factory in Alabama. Construction of a Birmingham plant for manufacture and repair of large electrical equipment was authorized.

Construction of the 150,000-sq-ft plant, to be at Reform near Tuscaloosa, is expected to start in a few weeks. Some 400 to 500 persons will be employed.

•

General Electric Outlines Executive Realignment

General Electric Co has announced the responsibilities assigned to its new executive vice presidents, Henry V. Erben, Hardage L. Andrews, and Roy W. Johnson (EW, Feb. 12, p 158).

Erben will be responsible for the Apparatus Group. This consists of

AN OLD COMPANY TAKES A NEW NAME

FREDERICK HART & Co., INC., *becomes* DAYSTROM ELECTRIC CORPORATION

Frederick Hart & Co., Inc., which has been manufacturing precision products at Poughkeepsie, New York, for more than 57 years, will henceforth be known as Daystrom Electric Corporation.

This action follows a change in the name of our parent company from ATF Incorporated to Daystrom, Incorporated.

The use of the name *Daystrom* offers distinct advantages in the introduction of new products. This name was chosen because it has become familiar to millions of people through national advertising of our companion subsidiary, Daystrom Furniture Corporation—world's largest producer of tubular steel furniture. Adding *Electric* to our name better identifies us with the type of products we make.

The advantage of this name will become even more apparent when fulfillment of contracts for the military services allows us to resume production of our normal peacetime products, such as the Hartron Sound Recorder-Reproducer.

Daystrom is new to the electronics industry in name alone. From Daystrom in the future — as from Hart in the past — will come new developments and new products to contribute to better living.

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DAYSTROM, INCORPORATED
ELIZABETH, NEW JERSEY

Subsidiaries:

Daystrom Electric Corporation — *sound recorders and electronic devices, Poughkeepsie, N.Y.*

American Type Founders — *letterpress, offset and gravure presses, foundry type and other printing equipment, Elizabeth, N.J.*

Daystrom Furniture Corporation — *chromed steel, wood and plastic furniture, Olean and Friendship, N.Y.;* Western Division, *Fullerton, Calif.*

Daystrom Laminates, Inc.—*plywood and lumber products, Daystrom, N.C.*

DAYSTROM ELECTRIC CORPORATION
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the present Large Apparatus Divisions, Apparatus Marketing, General Electric X-Ray Corp, and Locke, Inc. Andrews will be in charge of the Industrial Products and Lamp Group, including the Chemical Department, Construction Materials Department, Lamp Department, Small Apparatus Division, Carboloy Co, Inc, Monowatt, Inc, and Trumbull Electric Manufacturing Co. Under Johnson will be the Appliance and Electronics Group, made up of the Appliance and Merchandise Department, Air Conditioning Department, Electronics Department, Hotpoint, Inc, and Telechron, Inc.

SALES ASSIGNMENTS

COMPANY STAFFS

Locke, Inc, Baltimore, has named George A. Goddard regional manager at New York City and Hubert M. Carmichael to succeed him as regional manager at Atlanta, Ga.

General Electric Supply Corp has appointed Warren P. Shreve assistant manager of the Pittsburgh district. He has been manager of transmission line material sales since 1949.

American Steel & Wire Co, Cleveland, has appointed Robert A. Coates director of electrical sales for the western area, with headquarters in Chicago. He has been in the Chicago sales office. Named to a similar position in the central area, with headquarters in Cleveland, was Vernon W. Heimberger, who has held a number of sales posts in Cleveland. Curtis M. Vaill will direct electrical sales in the eastern area, with headquarters in New York.

Allis-Chalmers Manufacturing Co, Milwaukee, Wis., has named three new sales representatives to General Machinery Division district offices. They are Thomas C. Smith, Milwaukee; E. E. Strickland, Jr, New York; and Elwood C. Gerber, Pittsburgh.

REPRESENTATIVES

Star-Kimble Motor Division of Miehle Printing Press and Manufacturing Co, Bloomfield, N. J., has appointed Baldwin Co, 2935 Lovers Lane, Dallas, representative in Texas, New Mexico, and Oklahoma.

Muller & Harper, electrical manufacturers' representative, has changed its name to Muller, Harper & Associates, Inc. Headquarters are in the First National Bank Building, Pittsburg 22, Pa.

Metal Prices
Feb. 19, 1951

COPPER, Conn. V., lb	$ .24½
LEAD, N. Y., lb	.17
ZINC, prime Western, E. St. Louis, lb	.17½
TIN, Straits qual., N. Y., lb	1.83
ALUMINUM, ingot, base price	.19
NICKEL, base price	.50½
STEEL, billets, Pitts., ton	56.00
STEEL, scrap, No. 1 heavy, Pitts., ton	45.00

NATIONAL ELECTRICAL CODE HANDBOOK

1. Now contains 1949 supplement to the Code. Gives rules and requirements of all jobs; what they mean—how to apply them in accordance with the National Electrical Code. All rules for a job are grouped in one place. Covers definitions of Code terms and requirements applying to all wiring systems. **By Arthur L. Abbott. 8th Edition. 633 pages, 421 illus., $5.00**

ELECTRICAL ESTIMATING

2. In this manual is all the information you need to estimate the cost of any electrical construction job . . . quickly and accurately. Covers everything from the selection and training of estimators, and the proper use of estimating tools . . . to the cost of preliminary estimates, and the preparation of final bid sheets. Contains scores of sample estimates of actual construction costs. **By R. Ashley, Research Eng'r. 307 pages, over 190 illus., $7.50**

ELECTRICAL APPLIANCE SERVICING

3. How to test, repair, and service all home electrical appliances. Gives theory, constructions and trouble-shooting remedies on everything from toasters to refrigerators — from home wiring systems to resistance-heating appliances, motor-driven appliances, and refrigeration and air-conditioning appliances. Includes suggestions on how to set up and operate a servicing business of your own. **By William H. Crouse, Formerly Director of Field Education, Delco-Remy Division, General Motors Corp. 854 pages, 727 illus., $7.50**

PRACTICAL ELECTRICAL WIRING

4. This book makes every wiring job you tackle easier! Shows how to plan and carry out all types of light and power wiring jobs on the farm, in homes, factories, stores, schools, and similar structures. Based on the 1949 National Electrical Code, covers types of current, wire sizes, outlet boxes, service entrance and switch installations, new types of appliances, etc. **By H. P. Richter, Member International Assn. of Electrical Inspectors. 3rd Edition. 574 pages, 466 illus., $4.50**

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NEW ELECTRICAL CONSTRUCTION

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UTILITIES

Proposed Construction

Ala., Reform — Westinghouse Electric Co., First Natl. Bldg., Pittsburgh, Pa., light bulb plant, near here, **$1,500,000.**

Ark., Ozark—Arkansas Electric Co-operative Corp., Ozark, steam generating plant, **$10,558,000.**

Ind., Marion—I & M Electric Co., Marion, su-station at Van Buren and 11 mi. line from Liberty Center to Montpelier, $500,000.

Kansas—Wheatland Electric Co-operative, Scott City, 287 mi. rural distr. lines, 93.25 mi. conversion, 5.85 mi. retirement, Scott and Wichita Counties, $325,000. Frank Horton & Co., Lamar, Mo., engrs.

Ky., Paducah—Southern Bell Telephone & Telegraph Co., c/o B. F. Harwood, Paducah, underground conduit, $60,000.

La., Morgan City — Louisiana Quick Freezing & Cold Storage, Inc., c/o Victor Guarisco, pres., Morgan City, cold storage plant, **$250,000.**

Mass., Boston—Navy Dpt., 495 Summer St., Electric Service Bldg. 36 addns., alterations, Proj. 26440. Plans deposit $10.

Mass., Boston — Metropolitan Transit Auth., 31 James St., Tremont St. subway extension, **$11,500,000.** Praegar Maguire & Ole Singstad, 294 Washington St., consult. engrs.

Missouri—Barry Electric Co-operative, Cassville, 21 mi. rural distr. lines, sys. imprvs. **$230,000.** Frank Horton & Co., Lamar, consult. engrs.

Montana—Sun River Electric Co-operative, Fairfield, 75 mi. rural distr. lines and two-way radio in Cascade Co. **$120,000.** A. T. Fussel, Jr., Havre, consult. engr.

Nebraska — Consumers Public Power Dist., Columbus, sub-station at Rushville and office shop at Chadron. **$100,200.** R. L. Schacht, c/o owner, ch. engr.

Neb., Chadron — Consumers Public Power Dist., Columbus, sub-station. **$111,965.** R. L. Schacht, c/o owner, ch. engr.

Neb., Hastings—Central Nebraska Public Power & Irrigation Dist., Hastings, power plant, **$2,270,000.** G. E. Johnson, c/o owner, ch. engr.

New Hampshire—New England Power Co., 441 Stuart St., Boston, Mass., dam and hydro-electric power plant at Upper Fifteen-Mile Falls, near Littleton. **$45,000,000.**

New Mexico—Bureau Reclamation Dpt. Interior, Bldg. 1-A, Denver, Colo., transformer, shunt reactor, circuit breaker, disconnecting switches, disconnecting fuses, for Albuquerque Sub-station, Rio Grande Proj., Spec. DS-3319. L. N. McClellan, ch. engr.

N. Y., New Rochelle—Pub. Wks. Office, Third Naval Dist., 90 Church St., New York, Zone 7, electronic facilities alterations, Naval Reserve Training Center, NOY 23743, Spec. 26076.

N. Y., West New Brighton—Dpt. P. Wks., Municipal Bldg., New York, Zone 7, Contr. 1, general constr.; Contr. 2, electrical work and lighting for alterations, addns. for fire prevention work in Power House and Laundry Bldg., and Hospital Pavilions Nos. 1 to 8 (inclusive) of the Sea View Hospital, Brielle Ave. Plans deposit $10.

North Carolina — Skyline Telephone Membership Corp., West Jefferson, telephone sys., rebuild 20 mi. existing lines, 781 mi. new lines, 6 new dial central offices, Ashe Co. **$1,060,000.**

North Carolina—Blue Ridge Electric Membership Corp., Lenoir, rural distr. lines and imprvs., Caldwell Co. **$885,000.**

North Carolina—Four County Electric Membership Corp., Burgaw, rural distr. lines and imprvs. Pender Co. **$2,185,000.**

N. C., Fuquay Springs—Cornell-Dubilier Electric Corp., Hamilton Blvd., South Plainfield, N. J., electrical mfg. plant, Farmers Warehouse 1 and 2. **$1,500,000.**

O., McConnelsville—Ohio Power Co. (subsidiary of American Gas & Electric Co.) 305 Cleveland Ave. S. W., Canton, 400,000 kv power plant on Muskingum River, 12 mi. south of here, **$45,000,000.**

South Dakota — Bureau Reclamation, Dpt. Interior, Huron, 72 mi. Fort Randall —Winner 115-kv transmission line, Spec. DC-3318 Missouri River Basin Proj. Transmission Div.

Tenn., Knoxville—Electro Manganese Co., Proctor St., chemical plant. **$1,000,000.**

Tex., Waco—Texas Power & Light Co., 915 Wood St., Dallas, 80,000 kw. steam-electric generating station. **$4,500,000.**

Va., Charlottesville—State of Virginia, Richmond power plant apparatus and piping and insulation, at University of Virginia. Approx. $600,000. Plans deposit $5. Wiley & Wilson, American Bldg., Richmond, engrs.

Va., Norfolk-Portsmouth — Virginia Electric & Power Co., 7 and Franklin Sts., Richmond, power station in Norfolk-Portsmouth area. **$17,000,000.**

Washington—Pend Oreille Co. Public Utility Dist., Newport, hydro-electric dam at Box Canyon on Pend Oreille River, Ione, **$11,000,000.** Harza Eng. Co., 400 W. Madison Ave., Chicago, Ill., consult. engr.

Washington—Bonneville Power Admin., P. O. Box 3537, Portland, Ore., steam power generating plant, Port Angeles, **$15,000,000;** steam power generating plant, Longview, **$15,000,000.**

Wyoming—Bureau Reclamation, Dpt. Interior, P. O. Box 280, Reclamation Center, Casper, Wyo., furnishing, del. control and relay switchboards and battery charger for Seminoe Power Plant Addns. and Sinclair Sub-station, Kendrick Proj., and Transmission Div. Missouri River Basin Proj., Spec. 703S-169.

Low Bidders & Contracts Awarded

N. M., Jemez—Cooper-Bessemer, Mt. Vernon, O, Contract Awarded. **$776,250.** Power Plant. City, City Hall, Jemez, N. M. Awarded Jan. 29.

Idaho, Clark's Fork—Morrison-Knudsen Co., 319 Broadway, Boise, Idaho. Contract Awarded. **$40,000,000.** rein.-con. hydro-electric dam 170 ft. high with crest 500 ft. long at Cabinet Gorge, with four 27 ft. diam. concrete-lined penstocks, powerhouse, diversion tunnels. Washington Water Power Co., W. 825 Trent St., Spokane, Wash. Ebasco Services, Inc., 2 Rector St., New York, N. Y., engr.

INDUSTRIAL, COMMERCIAL & PUBLIC BUILDINGS

Proposed Construction

Ind., Fort Benjamin Harrison—Dpt. Army, Pentagon Bldg., Wash., D. C., plans by Harley Ellington & Day, 153 E. Elizabeth St., Detroit, Mich., finance center. **$20,000,000.**

Ia., Camanche—North American Steel Co., C. A. Depue, pres., Clinton, steel plant. **$100,000,000.**

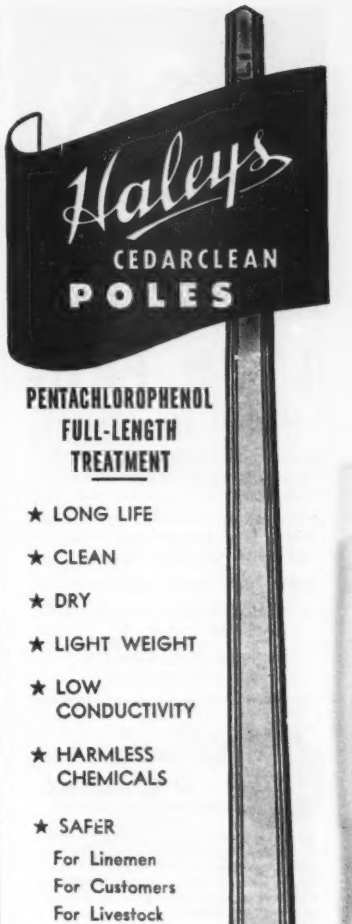
O., Portsmouth—Detroit Steel Co., 1025 Oakwood St., Detroit, Mich., 2nd blast furnace, 4 open hearth furnaces, blooming mill, hot strip mill and cold rolled steel mill. **$50,000,000.**

Tex., Houston—Sheffield Steel Corp., Industrial Rd. (subsidiary of Armco Steel Corp., Commerce Bldg., Houston Texas-parent owner), seamless tubing mill. Approx. **$20,000,000;** mill for mfg. steel ingots and plates. **$12,243,981;** blooming mill expansion, **$16,500,000;** blast furnace, **$12,500,000;** open hearth furnace, **$10,275,000.**

Tex., Port Arthur—Gulf Oil Corp., Port Arthur, ethelene plant, Sabine Hy. and Taylors Bayou. **$10,000,000.**

Alaska — Puget Sound Timber Co., Ketchikan, pulp plant on Prince of Wales Island. **$35,000,000.**

Alta., Edmonton—Canadian Chemical Co. Ltd., c/o Celanese Corp. of America, 180 Madison Ave., New York, N. Y., plant on 320 acre property, 7 mi. east of here. **$40,000,000.**



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315-Kv AG&E Line

(Continued from page 76)

from Philip Sporn station to the Kanawha station near Glasgow, West Virginia, a distance of 63 miles. One circuit only is to be installed at the present time. This line will traverse rolling and mountainous sections of country, with spans up to 3,000 ft or more.

A value of 13,500 lb was chosen for a loading condition of ½-in. ice and 8-lb wind. This load is only 32½% of the tensile strength of the cable, but was chosen to give the most economical tower weight per mile of line for this particular topography where advantage can be taken of the rolling nature of the profile without resorting to high conductor tension. In flat country, on the other hand, higher tensions are indicated.

Only a single ground wire will be used. This will be installed at the center of the tower and will be a standard cable of 159 Mcm ACSR.

Line Hardware . . . Both armor rods and vibration dampers will be used. Although our experience with Stockbridge dampers on some 5,000 circuit miles of 132-kv line has shown that dampers are effective in preventing conductor breaks, the added precaution is taken of installing armor rods. This is partly due to the desire to prevent conductor damage from flashovers of the insulator strings. Armor rods after installation are 18½ ft in length. The dampers are installed at the ends of the armor rods, and, in addition to damping the vibration, are also designed to form corona shields for the clamps holding the ends of the armor rods. An unusual feature of the dampers is that they extend transversely from the conductors instead of longitudinally like the conventional Stockbridge dampers. The dampers are 29 in. long and weighs 25 lb. The weights themselves are made of aluminum.

Conventional - type suspension clamps will be used. Dead end clamps will be hydraulically compressed.

Transformer Insulation . . . As large savings in transformer costs are possible in the high voltage range if insulation can safely be reduced below present day standards, an intensive study of this problem was made.

Impulse (or BIL) requirements were

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studied first. The 60-cycle rating of the arrester which would seal against dynamic voltage was determined, based on the maximum line-to-ground overvoltage under fault conditions, and 10% added as a factor of safety. The protective level of this arrester (maximum IR drop when discharging 5,000 amp) was increased by 20%. This was the required BIL of the transformer. For the 315-kv rated system, the BIL so arrived at was 1,110, based on present day station type valve arresters. A reduction of about 5% in this BIL would seem to be justified, if advantage were taking of the diversity factor in stacking a large number of separate arrester units all of which would not have the maximum protective level. This would give a 1,050 BIL, the value now known as the 230-kv insulation class. However, this 1,050 BIL was not selected, as further study indicated that the 60-cycle voltage test requirements inherently produced a higher BIL, namely one of 1,125 kv.

1,125 BIL . . . On the basis of present-day transformer insulation characteristics, experience, and risks in setting the 60-cycle test at an impractical low figure, a 60-cycle one minute test of 500 kv was agreed upon as the lowest permissible. Since there is a pretty well defined ratio between 60 cycle-test and impulse test in high voltage transformers today, this 500-kv, 60-cycle test resulted in an inherent transformer impulse strength of 1,125 BIL. Thus the required 60-cycle test, in effect, set the BIL at a value higher than required for protection by the arrester. This in effect results in a protective margin of nearly 30% instead of 20% between the arrester level and the transformer BIL. This is in the right direction, since the arrester cannot be located at the terminals of the transformers on a high voltage system of this type on account of physical dimensions of the arrester and required electrical clearances, and the added impulse margin may well be partially consumed in this "distance factor."

The insulation for the transformers has been set at 500-kv, 60-cycle one minute test, and 1,125 BIL. These values were found to provide adequate insulation strength against switching surge voltages permitted by the arrester.

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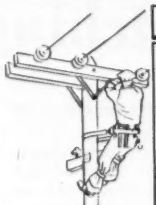

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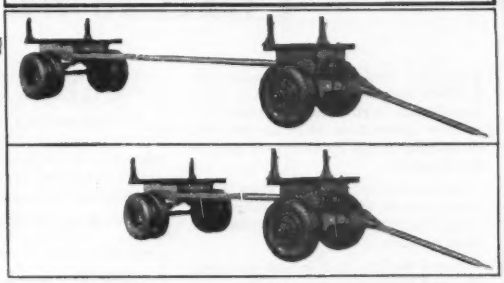

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Right now he's got you in a bad spot.

Ivan is afraid of only one thing.

He fears your ability to out-produce him in guns, tanks, planes.

Frankly, he doesn't think you value your free system enough to do it . . . to make willingly the sacrifices he has squeezed out of the Russians.

But he's wrong!

Because you and all of us have set out to build more and better weapons—to do it faster all the time.

We must use every bit of know-how and inventive skill we have to improve our machines and methods—to turn out more and more for every hour we work. Only in this way can we become militarily strong.

But we've got to supply essential civilian needs as well. We can't allow needless shortages to take prices skyrocketing and lower the value of our dollar.

Sure, that means sacrifices for everybody. But doing this double job well is the only sure way to stop Ivan in his tracks—and to save the freedoms which are ours and which he has never known.

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Good Lighting and Color

(*Continued from page* 86)

greater. Only changing the color of the paint results in appreciably more light on the task.

Employees' Health . . . This aspect is particularly of value to the older workers, since good lighting, in effect, magnifies the size of the task. The older workers whose eyesight has become poor can be employed longer on tasks requiring good vision. From the worker's standpoint, he is happier by being able to hold his good position longer.

Other specific aspects include less eye strain, decreased nervous tension, fewer headaches, and diminished fatigue.

Employees' Morale . . . Well lighted, cheerful, and colorful surroundings help greatly to keep the employees in better spirits, particularly during the last half of the work day. Some representative reports are:

1. Employees are happier when work areas are more pleasant and attractive.

2. Color relieves monotony of factor surroundings.

3. Workers are more contented with their jobs when color is used in the plant, especially if it is applied to moving parts of machinery.

4. Morale is greatly improved.

5. Employees enjoy the various color schemes used throughout the plant and offices.

Conservation of employees' eyesight, health, cheerful work areas, and better morale, are among the factors that indirectly affect production, and are among the principle subjects on which plant officials are continually seeking new, practical and economically sound answers.

Easier Maintenance . . . Almost universal satisfaction results from the improved housekeeping resulting from light and color conditioning. Reports from many employers state that there is greater pride in keeping newly painted work areas and machinery clean and there is even the tendency to censor other workers who are careless and untidy in handling their equipment. In some cases, the janitor service has been materially improved and maintenance costs have been decreased. Where decreased cost of maintenance is obtained, it is due to a certain extent to equipment being returned to its proper place with less likelihood of careless handling.

Reduction in Accidents . . . This is related directly to production in that accidents involve interference with production schedules. In the erection shops of a Milwaukee company, the accident frequency was reduced 43%. A Chicago manufacturer reported that their new painting contributed much toward a 73% reduction in accident severity rate. Another company reported 75% fewer accidents, reduction in the number of rejects and increases in production in the several departments of from 7 to 10%, due to color conditioning (with no change in the lighting).

Quality of Work . . . One-third of a group of manufacturers reporting on the use of color in their plants stated that they believe that it had improved the quality of production. The increase in visibility was indicated most frequently as the reason.

Functional Uses of Color . . . Color has functional uses also. It can provide backgrounds contrasting in hue with the immediate task, such as a blue-grey background against which white threads can be more easily seen in a textile mill. The second functional use is as a code for marking hazards. Yellow is used to indicate the need for caution, as to mark an obstruction hazard. Fire protection equipment is marked in red, and first-aid and safety equipment is green. White and black are standard for traffic marks. The third use is for the code marking of piping.

Office and Service Areas . . . While the discussion so far has centered on production areas, the morale, good housekeeping, and other non-critical seeing aspects applying to the service areas, and in the offices the production aspects in addition usually are applicable. In some offices, the production performance of the workers is a principle part of their duties. In one large government office, a two-year controlled study showed that after lighting and color conditioning, the brightness contrasts were reduced to one-twelfth and less of those obtained previously, and the increases in production ranged from 5.5 to 37.4%.

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3	3333	West.	132000—7620/13200Y
1	2000	G.E.	69300—13800/23900Y, 3ph.
3	1000	West.	66000—7200
3	100	West.	44000—7200/12470Y
3	75	G.E.	44000—2300/4600
3	8333	West.	43800—13900
4	6667	G.E.	38100/66000Y—12700/22000Y
6	150	G.E.	34500—4600/2300
2	7500	A.C.	33000—13200, 3 ph.
3	500	West.	33000—2400/4160
3	333	G.E.	33000—460
6	200	G.E.	33000—2300/6900
4	150	G.E.	33000—7200/12470
6	75	Mel.	33000/16500—2300/6900
3	75	Westg.	33000—7200/12470 Y
1	7500	G.E.	26,400 Rectifier Type
4	450	A.C.	25410/44000—13280/23000
3	750	West.	13200—440
3	333	G.E.	11000/22000—2400
3	200	Mel.	11000—2300
1	1500	West.	4000—2300, 3 ph. Auto
3	500	G.E.	4000—2300
3	250	A.C.	2300—460

INDUCTION REGULATORS

1—150 KVA. G.E. 200 A. 4000 V. 3 ph.
3— 46 KVA West. 200/400 A. 2300 V.
6— 36 KVA G.E. 150 A. 2400 V.
2— 36 KVA G. E. 75/150 A. 4800 V.

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4—400 A. 154 KV G.E. FHKO—39—2500MVA*
1—600 A. 132 KV G.E. FHKO—60—1500 MVA*
2—600 A. 73 KV G.E. FHKO—139—1000 MVA*
1—400 A. 73 KV G.E. FHKO—236—500 MVA*
1—600 A. 37 KV G.E. FHKO—139—450 MVA*
2—400 A. 37 KV G.E. FHKO—236—500 MVA*
4—600 A. 15 KV G.E. FHKO—139—750 MVA*
2—600 A. 15 KV West. B-28—B-500 MVA**
* Outdoor ** Indoor

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Phone Columbus 1-8532, 33, 34
W 9047, Electrical World
330 N. Michigan Ave., Chicago 11, Ill.

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Qu	KW	Make	Desc.
2—	750	G.E.	Condensing — 425 lbs. 750 TT. I.S.P. 440v. 3 ph. 60 cy — Built 1944
1—	625	Westg.	Non-cond. 125 lbs. I.S.P. 5/20 lbs. B. P. 440 v. 3 ph. 60 cyc.
1—	400	Westg.	Non-condensing—125/180 lbs. I.S.P. 5/10 lbs. B.P.—340/480 v. 3 ph. 60 cy.
1—	300	G.E.	Non-condensing 150/175 I.S.P. 5/10 B.P.—480 v. 3 ph. 60 cy.

SYNCHRONOUS CONDENSERS

	KVA	Make	Type	Volts	Speed
1—	6140	Whse.	TSC	2400/4150	600
1—	4000	G.E.		2400/4150	900
1—	3000	Whse.		2400/4800	720

MOTOR GENERATOR SETS

3 ph. 60 cy.

Qu	KW	Make	Speed	DC Volts	AC Volts
2—	2000	G.E.	600	600 25 cy	11000
1—	1500	G.E.	600	125/250	2300/4150
1—	1500	G.E.	360	275	2300/4400
1—	1000	Whse.	900	600	4150
1—	1000	G.E.	900	600	2300/4150
1—	750	G.E.	900	275	4150
1—	750	Whse.	900	275	2300/4150
1—	600	Whse.	900	250	440
1—	500	G.E.	720	125	2300
1—	400	G.E.	720	250	440/2300
1—	350	G.E.	900	125	4150

TRANFORMERS—60 Cycle

	KVA	Make	Type	Ph	Voltages
2—	2666	Whse.	OISC	1	66000x11000
2—	1250	G.E.	HVDDJ	1	6600x600
1—	600	Al. Ch.	OISC	3	2300/4150x220/440
3—	333	Pitts.	OISC	1	25400x2600
6—	250	G.E.	HT	3	13200x240/480
12—	250	G.E.	HT	3	2400/4150x240/480

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UNIT CAPACITIES—10 TO 1875 KVA
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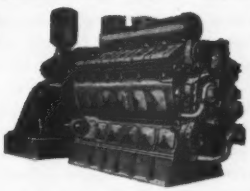
VARIOUS VOLTAGES



A PARTIAL LISTING OF OUR INVENTORY

KVA	Make	Model	HP	RPM	KVA	Make	Model	HP	RPM
1875	Fairbanks Morse	33F16	2000	300	375	Enterprise	DSC-6	450	480
1420	Fairbanks Morse	38DB8¼	1600	720	330	Superior	ENA	396	514
1250	General Motors	16-278A	1600	720	312	General Motors	8-268A	450	1200
937.5	General Motors	12-567	1080	720	312	Clark	MD-4	375	327
625	Alco	6-12¼x12T	750	600	187	Ingersoll Rand	8	225	514
425	Baldwin	VO-6	510	450	125	General Motors	3-268A	150	1200
400	Buckeye	80	480	600	75	General Motors	6043C	90	1200

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1—1000 KVA G.E., 3 Ph., 4150V 2 Ph., 2400V
1— 500 KVA Kuhlman, 1 Ph., 4150V, 2300V
1— 400 KVA G.E., 1 Ph., 6900V, 2300V Sec
5— 250 KVA Maloney, 1 Ph., 13,800V, 240/480 Sec
1— 75 KVA G.E., 3 Ph., 2400V, 240/480V Sec.
1— 50 KVA G.E., 1 Ph., 13,450V, 120/240V Sec.

WELDERS

2— 500 Amp. Westinghouse Flex Arc Welders 220/440 sing. phase

MOTOR GENERATOR SETS

2—1500 KW G.E., 900V, 600 RPM, 4000V Syn.
2—1250 KW G.E., 275V, 600 RPM, 4000V Syn.
1—1000 KW G.E., 600V, 514 RPM, 4000V Syn.
2— 150 KW G.E., 125/250V, 1200 RPM, 4000V Syn
2— 75 KW G.E., 250V, 1200 RPM, 220V Syn.

SLIP RING MOTORS

1—2500 HP G.E., MT, 257 RPM, 6600V
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1—2500 KVA Whse., 720 RPM, 2200V with D.C. Exc.

Large Stock of A.C. and D.C. Equipment

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"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
SINCE 1912 CINCINNATI 27, OHIO

LETTERS TO THE EDITOR

Industrial Heating

To the Editor of Electrical World:

Shall we sell gas or electric heat?

This question has plagued some combination utilities for many years—I say "plagued" because apparently most of them have not resolved any clear-cut policy on the question. Yet it can be resolved, and should be.

In industry, improved working conditions and controls resulting from refinement in heat applications effect savings in labor and materials which more than offset the relatively insignificant increase in heating cost. In a recent study in our area we found a 30% over-all labor saving and a 20% material saving with a new electric furnace installation, which resulted in an annual saving sufficient to wipe out the required investment in five months. In this case electric heating increased the heating cost item from 3.4% of total cost (with oil) to 7.7% of total manufacturing costs, exclusive of overhead and profit, and the investment was 60% higher than that for which new oil furnaces could have been installed. Yet the customer is very pleased with the results and is one of our best salesmen.

There is a strong temptation in the combination utility to favor gas sales, usually the weaker brother on revenue. But it should be borne in mind that, generally speaking, if a specific application goes electric, the revenue—and presumably the profits—are double those to be obtained from the same installation heated with gas.

There are natural markets for oil, gas and electric heat. If kept free of restraints, each will seek its economic level. Consequently electric heat at its higher Btu cost will be used only when it can be justified, gas with its relatively lower Btu cost is a logical contender where electric heating costs cannot be justified, and oil and coal will take over for the cruder applications.

These facts should be faced. The combination utility has no right to let its own interest influence the customer's decision towards either gas or electricity. Let both the gas and electric sales engineers do their best to make the sale—but recognizing that there is a difference in values—and let the best man win. That's the American way, and it's the best way. Recognize the fact that the two services are competitive and sell them competitively.

John Ludvig

Clinton, Conn.

We Were Wrong

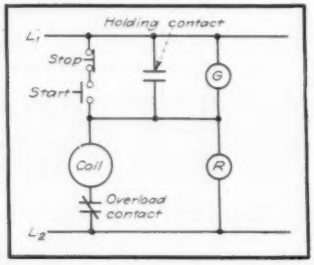
To the Editor:

I wish to call your attention to an error in the diagram on page 114 of the January 1st, 1951 issue of Electrical World.

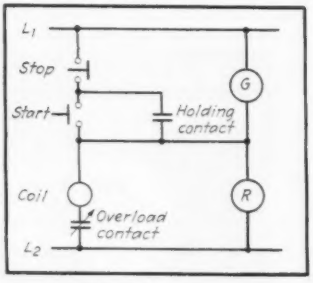
The diagram as shown, makes the "stop" button ineffective.

A corrected version of the diagram would help to analyze the merits and demerits of this circuit.

Louis B. Sklar
United Engineers & Constructors Inc
1401 Arch Street
Philadelphia 5, Pa.



THE WRONG ONE



THE CORRECT ONE

To the Editor:

In regard to the "Indicating Light Circuit" under discussion on the "Letters to the Editor" page in January 1, 1951 issue.

The circuit as shown is very likely to put anyone using it in a very embarrassing position. With the "holding" contact across both the "start" and "stop" button contacts it would be impossible to drop out the contactor by means of the stop button once the contactor was energized . . .

Winchel J. Goodwin
Electrical Design Engineer
4568 Rex Lake Drive
RD 10, Box 362C
Akron 18, Ohio

(Editors Note: Readers Sklar and Goodwin are correct, the circuit is wrong. In illustrating W. T. Fanjoy's letter (January 1, 1951, p 114) the incorrect diagram from Electrical World of August 14, 1950, p 112 was inadvertently substituted for the corrected diagram that appeared in "Letters to the Editor" of September 11, 1950, p 206. We re-publish both circuits with our apologies.)

Water Resources Policy

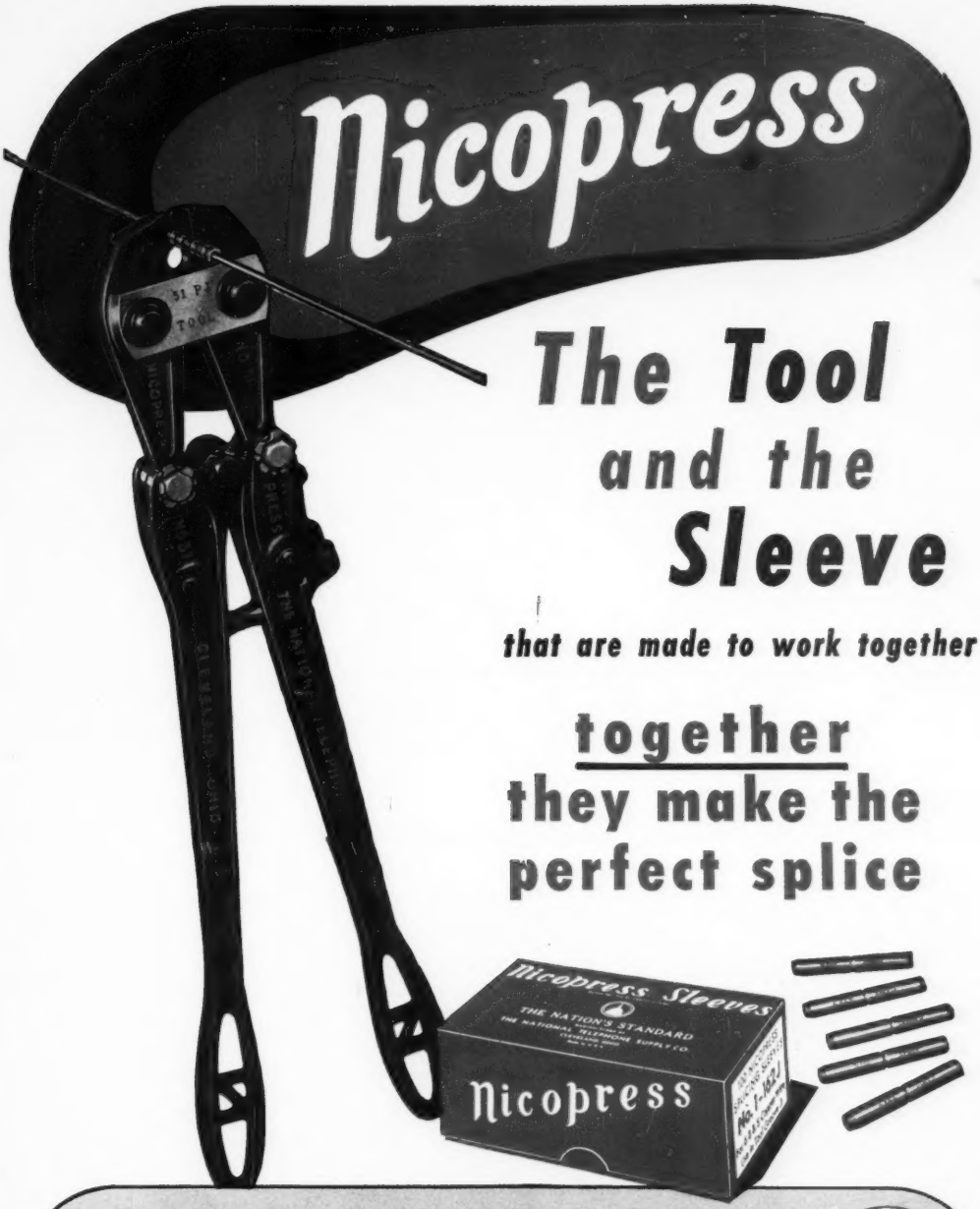
To the Editor:

I recently received my copy of "Electrical World" dated January 8, and was very pleased to see your forthright letter addressed to the so-called public representatives of the President's Water Resources Policy Committee.

I am sure there will be a lot of others, like me, who will want to offer their thanks and congratulations on this letter. It is straight to the point, and is the type of aggression which I think should be carried out a great deal by the utility industry itself, but it seems to me they have never had the courage to really do the job that should be done. Perhaps this letter of yours will be an incentive to them to go further than they have in carrying their battle to the public.

Elgin B. Robertson
Elgin B. Robertson, Inc
Dallas, Texas

Nicopress



The Tool and the Sleeve

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IT'S A FACT:

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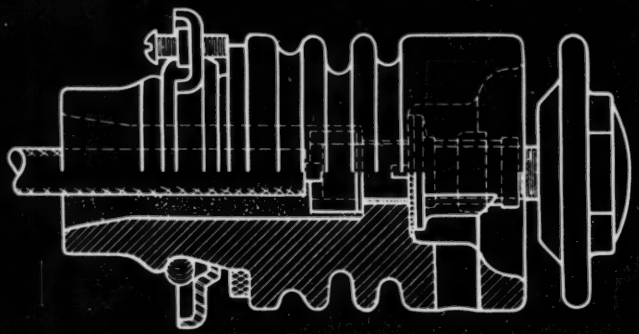

We're proud of the fact that the Kuhlman Quick-Grip bushing terminal, because of its outstanding safety and convenience, has become the most copied transformer bushing in America! Not only have its features been adopted by other transformer manufacturers, but it has also been specified as the preferred design by utility engineers.

Why? Because the heavy insulating knob by which connections are made prevents a lineman from making accidental contact with live parts. And, because the wire is connected to the terminal through the side, he does not have to grip over the lead as is the case where the wire enters a rotating chuck type terminal. Still an exclusive feature with Kuhlman Quick-Grip bushings: there is only one entry point for the line lead, which eliminates the possibility of the sharp point of the lead protruding on the opposite side of the bushing to provide a definite hazard to the lineman or his clothing.

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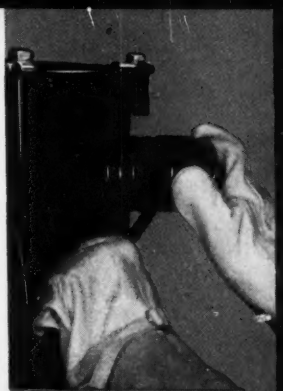
The Kuhlman Quick-Grip bushing is available on all Kuhlman transformers 5 KV and below where sidewall high voltage bushings are standard construction. Write today for full details.



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